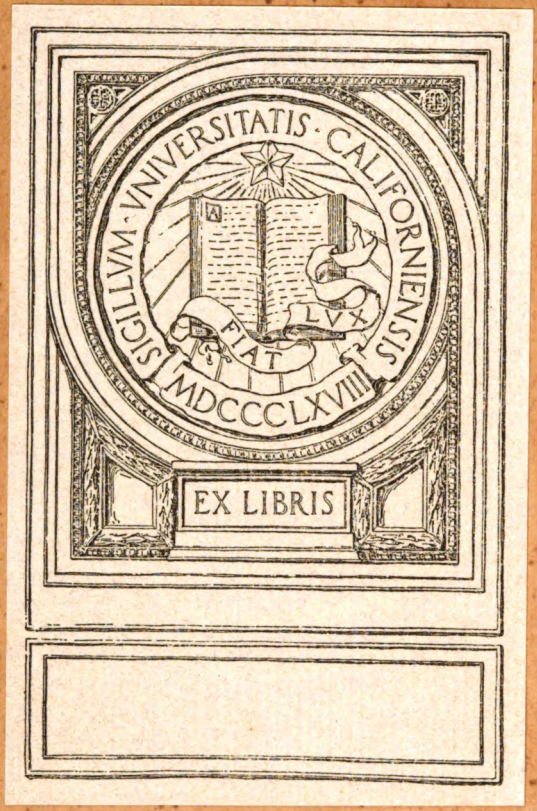

Gunners' Instruction

1922

Supplement for
12-INCH GUN (Disappearing Carriage)

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-------- Company, Fort----------

C. A. School, Fort Monroe, Va., 11-23-22-3000.

Again the JOURNAL expresses its grateful appreciation to the officers and soldiers of this Corps and of the School who have rendered it valuable assistance in the preparation of text and illustrations for "Gunners' Instruction."

As in the past, the JOURNAL will appreciate having brought to its attention suggestions looking to the perfecting of the pamphlet.

"Gunners' Instruction" is issued in separate pamphlets for Mines, for Mortars on Fixed Mounts, for Guns on Fixed Mounts, and for Railway Artillery.

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Supplements containing the Service of the Piece together with illustrations of the Gun Carriage and Breech are published for the

14-inch Gun—Disappearing Carriage
12-inch Gun—Disappearing Carriage
12-inch Gun—Barbette Carriage Model 1892
12-inch Gun—Barbette Carriage Model 1917
10-inch Gun—Disappearing Carriage
10-inch Gun—Barbette Carriage
8-inch Gun—Disappearing Carriage
6-inch Gun—Disappearing Carriage
6- or 5-inch Gun—Barbette Carriage
3-, 4-, 4.7-inch Gun—Rapid Fire
12-inch Mortar—Railway
8-inch Gun—Railway

These subjects for the Fixed Mortars are covered in the Gunners' Instruction pamphlet itself.

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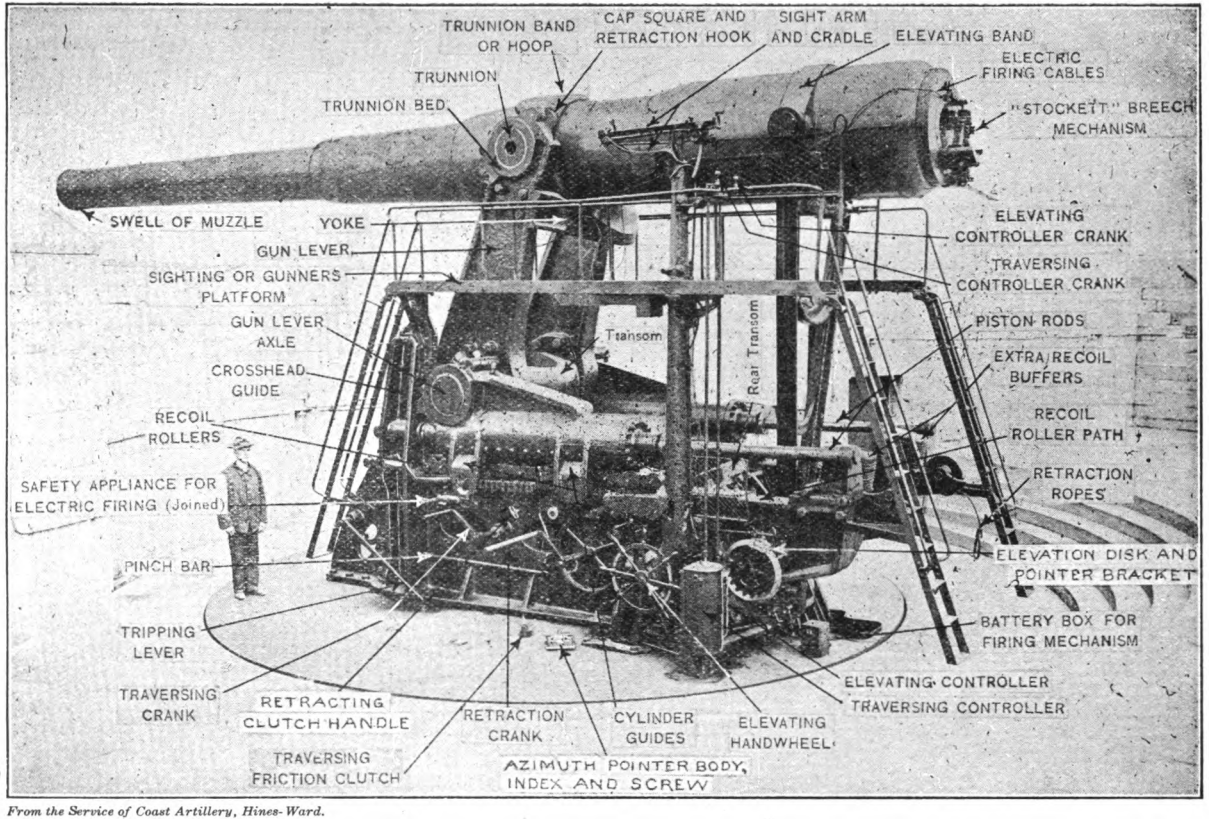
Fort Monroe, Va.



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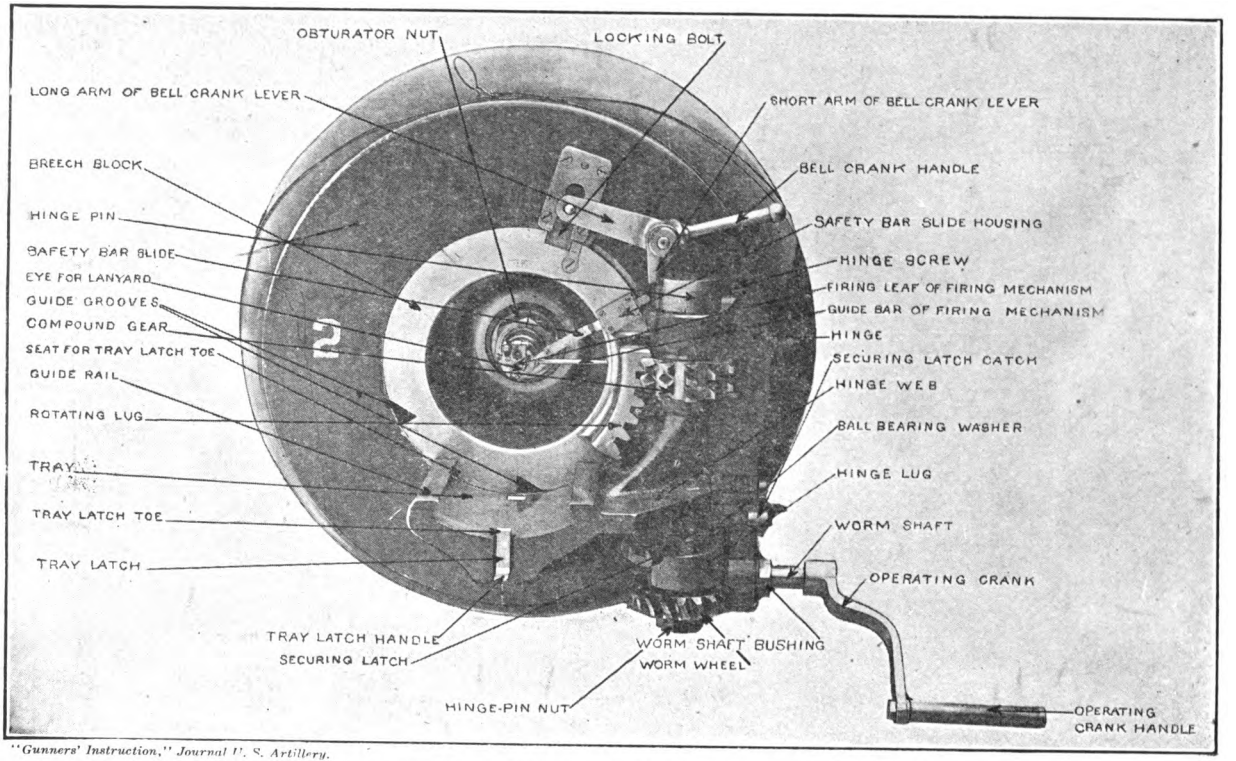
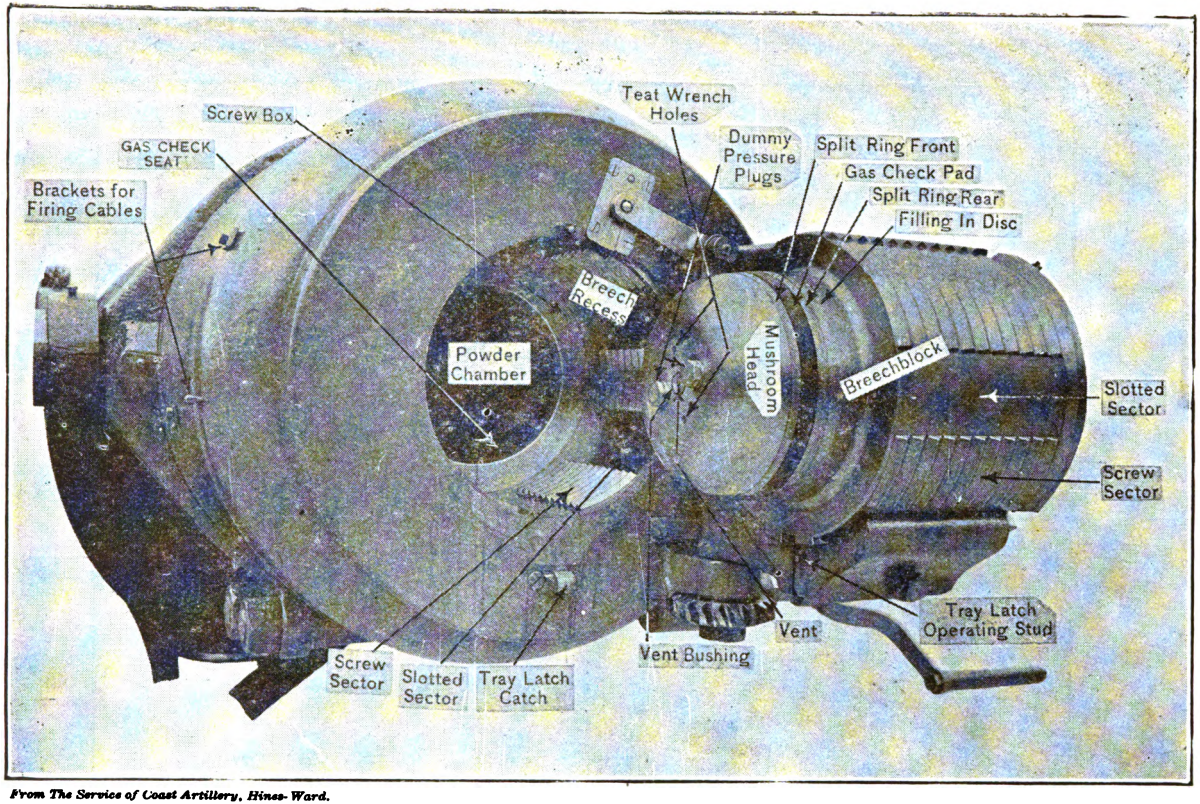
12-Inch B.L. Rifle, Model 1900, Mounted on D.C., L.F. Model 1901. "In Battery" (Firing Position)



"Gunners' Instruction," Journal U. S. Artillery.

Breech Mechanism, (Stockett), 12-Inch F. L. Rifle, Model 1900. (Closed)



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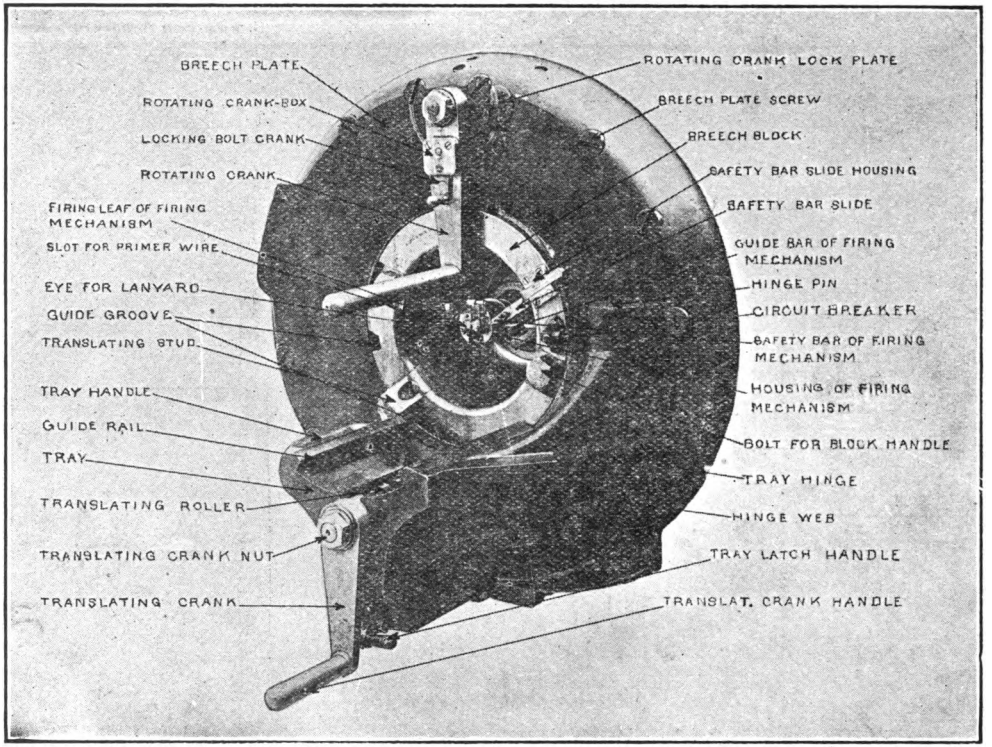
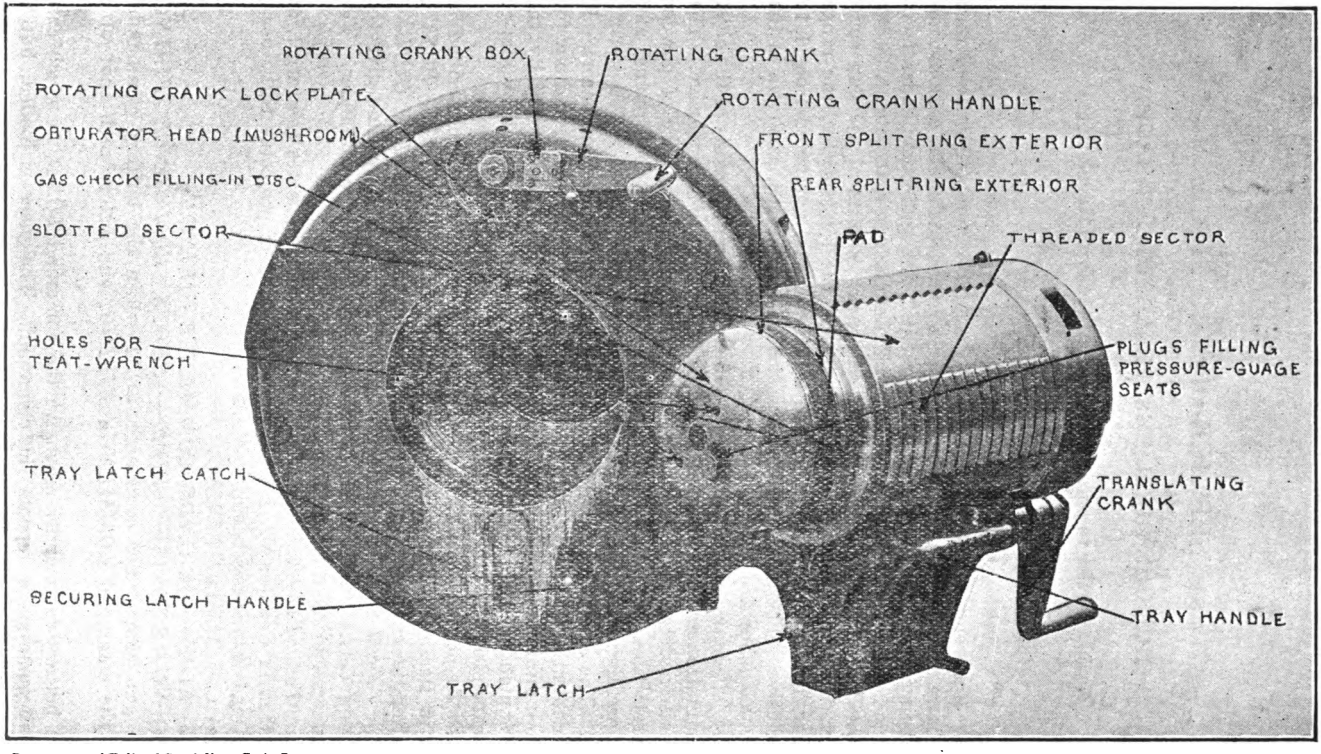


Department of Enlisted Specialists, U. A. S.

Breech Mechanism (Translating Roller Type), 10-Inch B. L. Rifle, Model 1888. (Closed)



Department of Enlisted Specialists, C. A. S.

Breech Mechanism (Translating Roller Type), 10-Inch B. L. Rifle, Model 1888. (Open)

(a) SERVICE OF THE PIECE

12-INCH GUN DRILL (DISAPPEARING CARRIAGE)

(Numbers refer to paragraphs in the 1914 Drill Regulations)

THE GUN SECTION

128. Each emplacement is manned by a gun section (42 enlisted men plus the reserve detachment), consisting of a gun detachment, an ammunition detachment, and a reserve detachment. The gun commander is in command of the gun section, and is also chief of the gun detachment.

129. The gun detachment (29 enlisted men) consists of the gun commander, the gun pointer, the chief of breech, the range setter, the range recorder, the deflection recorder, and 23 cannoneers, numbered from 1 to 23, inclusive. The gun detachment is divided into details, as shown in the drill which follows.

130. The ammunition detachment (13 enlisted men) consists of the chief of ammunition and 12 cannoneers, numbered from 24 to 35, inclusive. The ammunition detachment is divided into details for the service of powder and projectiles, according to the location of magazines, shot rooms, and hoists pertaining to the emplacement.

131. The reserve detachment consists of all unassigned cannoneers. It is divided into two reserve details, one for the gun detachment, and one for the ammunition detachment. The reserve detachment is posted by the gun commander at some convenient place or places, and is used by him to fill vacancies in the other detachments.

132. *To post the gun section.*—The section is posted as prescribed in detail in Par. 40. The gun commander commands *DETAILS, POSTS,* and after the cannoneers are posted, he commands *EXAMINE GUN.*

133. *To call off.*—The battery commander may at any time give the command *CALL OFF,* which is repeated by the gun commander. The cannoneers call off their numbers, beginning at one.

134. *To load and fire.*—The battery commander indicates the target, as prescribed in Chapter V. He designates the kind of projectile to be used, and after tracking has begun, commands:

(a) *COMMENCE FIRING.*

(b) *FIRE——ROUNDS, COMMENCE FIRING.*

(c) *NUMBER (S)——FIRE——SHOTS, COMMENCE FIRING.*

The gun commander commands *LOAD* when the battery commander gives the command *COMMENCE FIRING,* and before each shot of a series.

The battery commander may give the command *LOAD,* in which case the gun commander repeats the command. The piece is loaded, but is held from battery until the battery commander commands *COMMENCE FIRING.*

When the number of rounds specified has been fired, the gun commander commands *CEASE FIRING*, at which command all cannoneers resume their posts.

When the number of rounds is not specified, the battery commander commands *CEASE FIRING*, and the gun commander repeats the command.

135. When dummy ammunition is used, the piece is unloaded at the command *CEASE FIRING*, unless otherwise ordered.

136. The following drill [page 3] is prescribed:

NOTES ON THE DRILL

137. The service of the piece as given above is for a gun with an 1895 breech mechanism. If the gun has an 1888 breech mechanism, the duties of the breech detail differ in the following respects: No. 1 assists in opening the breech, oils the threads, and assists in closing the breech; No. 21 assists on the translating crank, if necessary.

138. *To open breech, model 1888 mechanism.*—No. 2 releases the rotating crank by turning the wing nut of the catch to the left and then turns the rotating crank clockwise, as indicated by the "open" arrow, until it brings up short in a horizontal position and is secured by its catch; No. 1 turns the translating crank briskly contraclockwise. When the shoulders of the grooves strike against the ends of the rails, the block stops short and the shock frees the tray latch from its catch; No. 1 swings the tray and block to the right until the securing latch engages in the catch.

139. *To close breech, model 1888 mechanism.*—No. 2 releases the securing latch from its catch; No. 1 swings the tray and block around to the left smartly; No. 2 seizes the handle of the tray and continues the swinging of the block until the tray abuts against and is latched to the face of the breech; then he turns the translating crank clockwise until the breech is translated completely; No. 1 releases the rotating crank by turning the wing nut and turns the rotating crank contraclockwise, as indicated by the "close" arrow, until it brings up short in a vertical position and is secured by its catch.

140. *To open breech, model 1895 mechanism.*—The chief of breech unhooks the lanyard (when one is used) from the eye of the firing leaf; No. 21 turns the crank continuously in a clockwise direction until the tray comes to a rest against the hinge plate and the securing latch catches.

141. *To close breech, model 1895 mechanism.*—No. 1 releases the securing latch and turns the crank in a contraclockwise direction until the projecting shoulder on the rotating lug striking the gear prevents further motion. The latch is released before the truck is withdrawn from the breech, holding the breech open by the operating crank until time to close it.

142. With the 1895 breech mechanism, it will be convenient to fasten a wire around the piece back of the elevating band with a loop in which the safety lanyard (if a lanyard is used) may be hooked during the loading. The chief of breech after unhooking the lanyard swings it over the teeth of the breech mechanism and hooks it in the loop of the wire. Thus it is kept from being caught in the mechanism and is convenient to the chief of breech when the time comes to hook it again.

143. Prior to practice or action shot trucks are adjusted to the highest point to which it is anticipated the gun will recoil, since the adjustment is made downward more easily and rapidly than upward.

144. If the gun fails to go in battery completely, the gun commander orders Nos. 9, 10, 22, and 23 to use the pinch bars; these are engaged in the

Details.	At command *DETAILS, POSTS.*	At command *EXAMINE GUN.*
Gun commander (N. C. officer).	The gun commander gives the command *DETAILS, POSTS,* and supervises the procuring of equipment and implements. He posts the reserve detachment.	The gun commander gives the command *EXAMINE GUN,* makes a general inspection of the gun and carriage, and reports to the emplacement officer.
Gun pointer (N. C. officer or private).	The gun pointer procures the sight, places it in its seat, and takes post on the sighting platform.	The gun pointer examines the sight and verifies the adjustment of the azimuth index. He examines the traversing mechanism and the electric firing mechanism and circuit (if used).
Range setter (N. C. officer or private).	The range setter takes post facing the range scale.	The range setter examines the elevating and retracting mechanisms, and cleans and oils the gears if necessary.
Range recorder (N. C. officer or private).	The range recorder procures chalk, a ruler, a blackboard eraser, and a stop watch, and takes post at the time-range board.	The range recorder examines the time-range board. He puts on the head set and tests the telephone to the plotting room.
Deflection recorder (N. C. officer or private)	The deflection recorder procures chalk and a blackboard eraser, and takes post at the deflection recorder's board.	The deflection recorder examines the deflection recorder's board. He puts on the head set, and tests the telephone to the plotting room.
Breech detail, chief of breech (N. C. officer or private), and Nos. 1, 2, 3, and 21.	The chief of breech takes post 2 yards in rear of the breech, facing it. No. 1 procures a wiper or cotton waste and a can containing lubricating oil and a sponge. He places the can convenient to the breech and takes post about one yard to the rear and right of the breech, facing it. No. 2 procures the operating crank for the breech mechanism and places it in position. He also procures a wiper or cotton waste and takes post about one yard to the rear and left of the breech, facing it. No. 3 procures the lanyard (if one is used), primers, primer pouch, punch, drill, reamer, and firing mechanism, and takes post on the right side of the piece about one foot to the right and front of the elevating band, facing to the rear. No. 2 takes post about 2 feet to the right of the breech on line with its face, facing it. (*Note:*—The distances of Nos. 1, 2, 3, and 21 from the breech may be increased.)	The chief of breech examines the breech mechanism, breechblock, breech recess, chamber, and bore, and gives the necessary orders for cleaning and putting them into condition for service. Nos. 1 and 21 remove the breech cover and place it at the designated place. They clean and oil the breechblock and breech mechanism. No. 2 cleans and oils the breech recess and gas-check seat. No. 3 examines the vent and the firing mechanism. He clears the vent and cleans the primer seat. He coils the long lanyard (if one is used) and hangs it over the end of the elevating arm.

At command *LOAD*	At command *CEASE FIRING.* (When dummy ammunition is used.)
The gun commander gives the command *LOAD* and supervises the work of his section. After the chief of breech has given the command *TRIP*, the gun commander sees that the gun goes fully into battery, verifies the range setting, and if the setting is correct, calls *READY*.	The gun commander gives the command *CEASE FIRING* and supervises the work of unloading.
The gun pointer sets the deflection recorded on the deflection-recorder's board and directs the traversing so that he will be on the target by the time the gun is in battery. He fires the piece or gives the command *FIRE* as soon after the command *READY* as the piece is pointed.	No duties.
At the command *TRIP* the range setter lays the piece for range in accordance with information obtained from the time-range board, as described in Par. 400.	No duties.
The range recorder continues plotting the time-range curve as prescribed in Par. 400.	The range recorder continues plotting the time-range curve.
The deflection recorder makes a record of the last deflection received when it differs from the last one recorded, erasing the latter.	The deflection recorder continues recording deflections.
The chief of breech gives the command *HOME RAM* for ramming the projectile, and the command *IN BATTERY, TRIP* for tripping the gun. If a lanyard is used, he hooks the lanyard before the primer is inserted, and does not command *TRIP* until after the primer is inserted. After firing, he unhooks the lanyard. No. 1 places the head of the rammer against the base of the projectile as the truck approaches the breech, assists in ramming the projectile, closes breech, assisted by No. 2, and goes to his place on the rammer and stands by for the next shot. After each shot, No. 2 wipes off the mushroom head and gas-check seat, then takes his place on the rammer, assists in ramming the projectile and assists No. 1 in closing breech. No. 3 inserts a primer after the breechblock is completely closed and lowers the leaf of the firing device *completely down*, steps back to the rear as the gun goes in battery, letting his lanyard (if one is used) uncoil, and pulls the lanyard (if one is used) at the command *FIRE*. After the piece is fired he coils the long lanyard (if a lanyard is used) and as soon as the breech is opened removes the old primer, clears the vent, and cleans the primer seat. No. 21 opens breech, and cleans and oils the breechblock when necessary. He assists No. 1 with the crank when there is difficulty in closing the breech. If the projectile fails to seat at the first trial, he assists on the rammer. *Note*—(The battery commander may require Nos. 1 and 2 to assist in rammnig the powder, and the chief of breech to assist in ramming the projectile.)	The chief of breech supervises unloading. Nos. 1 and 2 assist in withdrawing the dummy powder charge and the dummy projectile. No. 3 removes the primer. No. 21 opens breech and assists in withdrawing the dummy projectile.

Details.	At command *DETAILS, POSTS.*	At command *EXAMINE GUN.*
Rammer detail, Nos. 4, 22, and 23.	Nos. 4 and 22 procure the rammer and place it on the hooks near the rail, head toward the hoist. No. 4 takes post about 2 yards from the head of the rammer, within reach of the staff, facing the piece. No. 22 takes post four yards to the left of No. 4, facing the piece. No. 23 procures the extractor for the dummy projectile and places it near the rammer, takes post four yards to the right of No. 4, facing the piece.	No. 4 assists the breech detail in cleaning when necessary. No. 22 removes the muzzle cover, hands it to No. 8, who places it at the designated place. No. 23 assists No. 9 in filling the recoil cylinders, passing up the oil measure and the funnel when needed.
Elevating detail, Nos. 5 and 6.	Nos. 5 and 6 take posts at the elevating handwheel on the same side as the range setter, facing the piece.	Nos. 5 and 6 assist the range setter in examining the elevating and retracting mechanism, and in cleaning and oiling the gears.
Traversing detail, Nos. 7 and 8.	Nos. 7 and 8 procure the traversing cranks, place one of them on the shaft, on the same side as the gun pointer, and take posts at the crank, facing to the rear.	Nos. 7 and 8 remove the drip pans, assist in testing the traversing mechanism. No. 8 receives the muzzle cover from No. 22 and places it at a designated place.
Tripping detail, Nos. 9 and 10.	No. 9 procures a wrench for filling plugs, a measure containing hydrolene oil, and a funnel, and goes to the right tripping lever. No. 10 procures a wrench for filling plugs and goes to the left tripping lever.	Nos. 9 and 10 mount on the chassis, each carrying a wrench, and remove the filling plugs from the recoil cylinders. If oil is needed, No. 9 calls on No. 23 for the funnel and measure, and pours oil into the right cylinder slowly. No. 10 watches the oil hole in the left cylinder. When both cylinders are full, No. 9 hands the funnel and measure back to No. 23 and notifies the gun commander that the cylinders are ready for inspection. After the inspection, Nos. 9 and 10 screw the plugs well home and take posts, facing the piece, by the platform railing, No. 9 three yards to the right of No. 4, and No. 10 three yards to the left of No. 4.
Truck detail, Nos. 11 and 12.	Nos. 11 and 12 bring out the shot trucks to be used and take posts at the handles of one of the trucks; No. 11 on the right and No. 12 on the left.	Nos. 11 and 12 examine the trucks, clean and oil them when necessary. They then turn them over to the hoist detail for loading. When the first truck is loaded, they push it out to some convenient position in rear of the breech.
Powder serving detail, Nos. 13, 14, 15, and 16.	Nos. 13, 14, 15, and 16 bring out the powder trays to be used and turn them over to the ammunition detachment. They take posts opposite the first tray, loaded, Nos. 13 and 15 on the right and Nos. 14 and 16 on the left; Nos. 13 and 14 in rear.	Nos. 13, 14, 15, and 16 see that the powder sections are arranged on the trays in the order in which they are to be inserted.
Hoist detail, Nos. 17, 18, and 19. No. 17 is chief of detail unless a N.C. officer is assigned in charge	Nos. 17, 18, and 19 take posts at the delivery table.	Nos. 17, 18, and 19 examine and clean the delivery table and the projectiles on it. They examine the automatic stop. They load the trucks turned over to them by the truck detail.

At command *LOAD*.	At command *CEASE FIRING*. (When dummy ammunition is used.)
The truck is brought up to the face of the breech, and the projectile pushed carefully off the truck until the base of the projectile is just inside the powder chamber. The truck is then withdrawn and run off to one side. Nos. 1, 2, 4, 9, 10, 21, 22, and 23 then man the rammer as near the outer end as possible, and at the command *HOME RAM* by the chief of breech, they rush the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat. The rammer detail pushes the powder off the powder tray and into the powder chamber to such a distance that the breechblock will give the powder charge a final push into the chamber in closing. Note.-If considered desirable by the battery commander, he may require the chief of breech to assist in ramming the projectile and Nos. 1, 2, 9, and 10 to assist in ramming the powder.	No. 4 brings up the extractor and pulls the dummy powder sections back on to the tray. He hooks the extractor into the dummy projectile and assists in withdrawing it. Nos. 22 and 23 assist in withdrawing the dummy projectile.
Nos. 5 and 6 elevate or depress the piece under direction of the range setter.	No duties.
Nos. 7 and 8 traverse the piece under direction of the gun pointer. They halt when the piece is fired and resume traversing as soon as the truck is withdrawn from the breech.	No duties.
Nos. 9 and 10 assist in ramming the projectile. As soon as the projectile is seated they quit the rammer and run to the tripping levers. At the command *IN BATTERY* they seize the tripping levers, and at the command *TRIP*, raise them quickly to the stops, hold them for an instant, then let go, and when the gun is in battery run back to their posts at the rammer, where they stand by for the next shot. If firing by electricity, No. 9 (or No. 10) closes the safety switch as soon as the gun is in battery. (Note.-If considered desirable by the battery commander, Nos. 9 and 10 may assist in ramming the powder.)	No duties unless the dummy projectile sticks, in which case they assist in starting it from its seat.
Nos. 11 and 12 run out a loaded shot truck, No. 12 adjusting the truck to the proper height in accordance with the position of the piece upon recoil. The truck is run forward so that the tray enters the breech recess squarely. As the truck brings up against the face of the breech No. 12 sets the brake. As soon as the projectile is pushed off the truck, Nos. 11 and 12 run the truck back to the hoist and turn it over to the hoist detail. They then take posts behind a loaded truck and stand by for the next shot.	Nos. 11 and 12 push a truck into position at the breech to receive the dummy projectile, then return the truck to the loading position.
As soon as the rammer has been withdrawn after seating the projectile, the nose of the powder tray is inserted in the breech by Nos. 13, 14, 15, and 16, and the rammer detail, in one motion, pushes carefully the entire powder charge off the tray to such a distance that the breechblock will give the powder charge a final push into the chamber in closing. The tray is then removed and the breech closed.	Nos. 13, 14, 15, and 16 bring up an empty powder tray to receive the dummy powder sections, and return the loaded tray to the loading position.
Nos. 17, 18, and 19 receive the empty truck after each shot, load it, and run it out conveniently for Nos. 11 and 12.	No duties.

Details.	At command *DETAILS, POSTS.*	At command *EXAMINE GUN.*
Sponge detail, No. 20.	No. 20 procures the chamber sponge and a vessel containing liquid for sponging, places them on the opposite side of the emplacement from the rammer, and takes post near the chamber sponge, facing the gun. (If there is to be no firing, the vessel may be empty.)	No. 20 brings up the chamber sponge when called for and assists in sponging the chamber.

At command *LOAD.*	At command *CEASE FIRING.* (When dummy ammunition is used.)
No. 20 dips the chamber sponge in the liquid for sponging and allows the excess liquid to run off as soon as the breech is opened after each shot, assisted by the breech detail, he sponges the chamber as quickly as practicable.	No duties.

notches on the chassis and the gun is forced into battery. However, battery commanders will observe such defects at daily drill and will have the same remedied before practice or action.

145. *To retract the gun.*—Assuming that the gun is in battery, that the clutch is out, and that the cables are wound on the retraction drums, to retract the gun by hand the gun commander will command (1) *FROM BATTERY*, (2) *HEAVE*, (3) *HALT*. At the first command No. 7 releases the retaining pawl and turns the speed crank to permit the pulling out of the cables. Nos. 1 and 2 pull out the cables to their full length and pass the ends to Nos. 21 and 4, who will have mounted on the chassis. Nos. 21 and 4 pass the cable to Nos. 9 and 10, who will have mounted the gun levers, and who will place the ends of the cables on the hooks. No. 7 will then throw on the retaining pawl and will turn the speed crank to take up all slack, and No. 8 will push in the clutch, Nos. 21 and 4 watching the cables to see that they take the grooves of the drums. As soon as the slack has been taken up Nos. 4, 21, 9, and 10 return to the loading platform, and Nos. 7 and 8 put on the retraction cranks.

The gun section is divided into two reliefs by the gun commander. The first relief takes post at the retraction cranks, and at the second command start to retract the gun. The reliefs alternate as directed by the gun commander. As soon as the crosshead teeth engage their pawls the retraction shaft retaining pawl is thrown off, and remains off until the cables have been unhooked from the gun levers.

When the gun has reached the loading position, the gun commander commands *HALT*. At this command Nos. 7 and 8 remove the retraction cranks. No. 7, using the speed crank, lets out enough slack to enable Nos. 1 and 2 to unhook the cables. After the unhooking, No. 7 takes up all slack with the speed crank and then throws the retaining pawl on. No. 8 then pulls out the clutch.

146. For retraction by power the above drill is modified as follows: Assuming the idler to be out of gear, after the cables have been hooked to the gun levers and the slack has been taken up by No. 7 and the clutch thrown in by No. 8, at the command *HEAVE* by the gun commander, No. 8 throws the idler in gear. As soon as this is done the range setter closes the main switch of the controller cabinet and moves the arm so as to turn on the power. The movements at the command *HALT* are the same as those prescribed for hand retraction, except that the range setter pulls the main switch of the controller cabinet, after which No. 8 throws the idler out of gear. The cables are then unhooked, and the slack taken up as prescribed for hand retraction.

147. On carriages equipped with friction brakes on the retraction crank shaft it is not necessary to unhook the cables from the gun levers. The time consumed in pulling out and hooking the cables is thereby saved. On carriages so equipped the cables need not be unhooked, and the drill may be modified accordingly.

Gunners' Instruction

Fixed Guns

1923

(Sixteenth Edition)

Book Department
COAST ARTILLERY SCHOOL
FORT MONROE, VIRGINIA

EXTRACTS FROM INFORMATION CONCERNING COURSES FOR ENLISTED MEN AT THE COAST ARTILLERY SCHOOL, FORT MONROE, VA.

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High School Arithmetic—Wentworth and Hill
New School Algebra—G. A. Wentworth
Elementary English Composition—Scott and Denny
Modern Business Penmanship—Williams and Rogers Series
Words—SoRelle and Kitt
New English Grammar—Harvey

Any of the above mentioned books may be purchased at the lowest prices from the BOOK SHOP, COAST ARTILLERY SCHOOL, Fort Monroe, Va.

For any further information concerning any of the courses mentioned above, address, The Secretary, Coast Artillery School, Fort Monroe, Va.

Gunners' Instruction

(Gun Companies)

_____Company, Fort_____

1923

BOOK DEPARTMENT
COAST ARTILLERY SCHOOL
Fort Monroe, Va.

C. A. School, Ft. Monroe, Va., 9-28-23-1000.

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Contents

GUN COMPANIES

Second Class

First Class

APPENDICES

GUN COMPANIES

SECOND CLASS

(a) SERVICE OF THE PIECE. See supplement.

(b) NOMENCLATURE OF THE VARIOUS PARTS OF THE GUN AND CARRIAGE; and,

(c) ACTION, ADJUSTMENT AND CARE OF THE VARIOUS PARTS OF GUNS AND CARRIAGES

Q. To what guns is your company assigned?
A. Battery....,....-inch guns, model.....
Q. What kind and model of carriage?
A. .....carriage, model.....

GUNS

Point out or describe location of such of the following parts as apply to the guns of your battery:

Breechblock.
Breechplate.
Breech recess.
Breech reinforce.
Centering slope.
Chase.
Compound gear.
Electric firing circuit:
  Firing cable.
  Circuit breaker.
Exterior split rings.
Filling-in-disc.
Firing mechanism:
  Ejector.
  Guide bar.
  Hinged collar.
  Safety bar.
  Safety bar slide.
  Safety bar slide housing.
  Firing leaf.
  Slide.
  Slide stop.
  Contact clip.
  Contact clip housing.
Forcing cone.
Gas-check pad.
Gas-check seat.
Gear segment.
Grooves.
Guide rails.
Guide groove.
Hinge pin.
Hoops.
Lands.
Interior split ring.
Loading tray.
Locking slide.
Lock nut.
Main bore.
Mushroom head.
Muzzle.
Obturator spindle.

Obturator. spindle nut.
Oil holes.
Operating crank.
Operating lever.
Powder chamber.
Pressure plugs, dummy.
Rotating crank.
Rotating crank catch (lock).
Safety lanyard device.
Safety lock.
Securing latch.
Securing latch catch.
Screw sectors.
Slotted sectors.
Teat-wrench holes.
Translating roller.
Translating stud.
Tray.
Tray ball bearing.
Tray latch.
Tray latch catch.
Tray latch operating stud.
Tube.
Vent.
Vent bushing.
Washers, bronze and steel.
Worm wheel.

Q. Explain how to attach and adjust the firing mechanism.

A. Clasp the hinged collar about the spindle; slip the safety bar into the notch of the housing; hold the housing over the hinged collar and screw the latter into the housing until the spring catch engages. While doing this, see that the guide bar enters the groove in the breechblock and the pin of the safety bar slide enters the hole of the safety bar.

Put the ejector in place with the ejector raised and the slide stop pulled out. Place the slide in position.

Q. Take off and put on the firing mechanism.

NOTE.—To avoid accident through a premature explosion, the greatest care must be taken of the firing mechanism.

It should be frequently tested with an unfired service primer and *must* always be so tested before service practice.

To test, insert an unfired service primer and rotate the breechblock slowly and completely to its firing position, having, during this rotation, a strong steady pull on the lanyard, sufficient to fire the primer. Should the primer fire, report the fact at once to the battery commander.

Q. Explain how the breechblock of a major-caliber gun is dismantled.

A. Open the breech, remove firing mechanism. Place shot truck with its tray under mushroom head, elevating the tray until it bears the weight of the mushroom head and spindle (have the tray covered with burlap so as to protect the mushroom head from scratching). Remove spindle nut and bronze and steel washers (or ball bearings or spindle springs)* and,

* In guns of models 1895 and 1900 ball bearings are substituted for spindle washers. In all 14-inch guns spindle springs are substituted for spindle washers.

holding rings and pad against the mushroom head, move truck back so as to withdraw spindle from block. Splitrings, gas-check pad and filling-in-disc may now be removed. In the case of barbette carriages it is more convenient to dispense with the truck and to have two men, with or without a sling (or using chain hoist), remove the spindle.

Q. How is it then assembled?

A. To assemble, proceed in reverse order, being careful to have the countersunk portion of the pad and the shoulder on the filling-in-disc towards the mushroom head. Firing mechanism is not placed on spindle until the mushroom head is adjusted.

Q. Explain how the breechblock of a 6-inch gun (model 1903) is dismounted:

A. Open the breech, withdraw the latch retainer and remove the latch. The breechblock is now free to be translated and rotated as if it were in the breech recess. Hold the block carrier and rotate the operating lever until translation of the block is completed. Remove the firing lever-pivot-pin and pivot. Lift the firing lever out of its slot in the block carrier. Lift the spindle key out of its slot in the block carrier. If the spindle key seems to stick, move the operating lever slightly to and fro until the key is free. Continue the rotation of the operating lever until rotation of the block is completed. Detach firing cable from the firing-cable bracket. Support the housing of the firing mechanism, and with the wrench provided for the purpose, rotate the mushroom head to the left until the housing is free from the spindle, when the housing may be withdrawn to the rear by holding down the rack-lock bolt. Remove the spindle from the block and remove the spindle spring. The operating lever should now be rotated a short distance farther. This causes the teeth on the end of the stem to enter the groove provided for them in the hub of the carrier. The stem of the block may now be removed from the carrier. Slide the rack to the left out of its groove. Remove the hinge-pin nut and take off the operating lever. Support the block carrier and drive out the hinge pin, using a copper drift. The block carrier and operating spool are now free to be removed.

To remove the loading tray, press down on the tray-latch bolt and lift the tray from its place.

To dismount the lever latch, force the latch bolt upward until the stud is free of its groove. Turn the bolt 180° until the stud points to the left, when the bolt may be lowered

out of the housing, the stud passing through a groove cut in the housing for this purpose.

Q. How is it then assembled?

A. Place the hinge-lug bushing in its seat so that one of the diagonals of its rectangular interior will be perpendicular to the face of the breech. Place the carrier bushing in its seat so that one of the diagonals of its rectangular interior will lie in the plane of the carrier. Support the carrier so that its plane is perpendicular to the face of the breech, placing its lugs in position to receive the hinge pin. Place the spool between the lugs of the carrier, and turn so that the circular lower end of the roller groove faces the body of the carrier. Insert the hinge pin carefully, using no force unless positive that the rectangular holes in the spool, hinge-lug bushing, and carrier bushing are in line. Place the operating lever on the hinge pin so that the lever lies in the plane of the carrier and screw on the hinge-pin nut. Rotate the operating lever slightly to the left and enter the stem of the breechblock in the carrier until the roller enters the roller groove. Place the rack in its groove. Press the block towards the carrier, at the same time rotating the operating handle slightly to the right and entering the stud of the rack in the rotating groove. Assemble the obturator and firing mechanism housing, being careful to stop the rotation of the mushroom head when the ejector drops into its slot in the spindle. The slide must be assembled in the housing before the housing is assembled to the spindle. Rotate the operating lever until rotation of the block is completed. Assemble the spindle key and firing lever; rotate the operating lever until translation of the block is completed. Insert the latch. On one end of the latch the dovetail projection for the latch retainer is cut away. This is the lower end of the latch. Assemble the latch retainer.

Q. Explain how the mushroom head is adjusted for firing.

A.* Close the breech with the spindle nut loose, but not loose enough to permit slipping of the pad or split rings. Rotate the block one-half. With the mechanism in this position screw up the spindle nut as tight as it can be screwed by one man with the wrenches provided.

It is necessary to insert the end of a screw-driver in the

* The only adjustment necessary with the 6-inch Model 1903 mechanism is, in assembling the breechblock, to turn the obturator until the rear end of the spindle is flush with the rear face of the firing mechanism housing and the mark on the spindle coincides with the mark on the housing.

opening of the nut in order to spread it sufficiently to allow its rotation without rotating the spindle.

Tighten the clamping screw on the spindle nut and rotate the breechblock until the breech is closed completely. This last operation presses the pad into its seat, due to the forward motion of the block. Then the pad should be in proper adjustment for firing; this may be tested by turning the mushroom head by hand. It should turn easily, but without play.

Q. Explain how to lubricate the gas-check pad.

A. A mixture of equal parts by weight of graphite and 4½ lubricant is applied to the entire surface and is rubbed into the pad covering with the fingers. The object is to reduce the absorption of moisture, cutting, or tearing.

CARRIAGES

Point out or describe the location of such of the following parts as apply to the gun carriages of your battery:

Parts common to both disappearing and barbette carriages

Azimuth circle.
Azimuth pointer.
Base ring.
Cap squares.
Cap square bolts.
Chassis.
Counter-recoil buffers.
Counter-recoil system:
  Pistons.
  Piston rods.
  Spring compressors.
  Spring rods.
Distance ring.
Dust guard.
Elevating band.
Elevating handwheel.
Elevating motor.
Firing magneto.
Followers.
Foundation bolts.
Glands.
Grease cups.
Leveling bolts.
Loading platform.
Lower roller path.
Oil holes.
Piston.
Piston rods.
Racer.
Range pointer.
Range scale.
Recoil cylinders.
Recoil racks.*
Recoil roller paths.
Recoil rollers.
Rimbase.
Safety firing switch.
Sight standard.
Stuffing boxes.
Throttling bars.
Transoms.
Traversing crank.
Traversing rack.
Traversing rollers.

* For 6-inch D. C. Models 1905, 1905 MI, and 1905 MII; and 14-inch D. C. Models 1907 and 1907 MII.

Trunnion.
Trunnion bed.
Upper roller path.
Yoke.

Parts pertaining to disappearing carriage only

Combination recoil and buffer valve
Connecting pipe.
Counter balance.
Counter-recoil system:*
  Buffer cylinders.
  Buffer springs.
  Equalizing and throttling pipes.
  Yokes.
Counterweight.
Crosshead.
Crosshead guides.
Crosshead pawls.
Crosshead pawl spring.
Crosshead racks.
Cylinder guides.
Elevating arms.
Elevating controller.
Elevating controller crank.
Elevating shaft.
Elevating slide
Equalizing pipe.
Filling holes.
Gun lever.
Gun lever axle.
Idler.
Maneuver lever.
Pinch bars.
Recoil buffers.
Retracting clutch handle.
Retracting cranks.
Retracting drums.
Retracting gear.
Retracting hooks.
Retracting ropes.
Safety latch (in tripping apparatus.)
Subcaliber platform.
Sighting (or gun pointer's) platform.
Throttling pipes.
Throttling valve.
Top carriage.
Traversing clutch handle.
Traversing controller.
Traversing controller crank.
Traversing gear slow motion.
Traversing motor.
Tripping levers.

Parts pertaining only to 12-inch Barbette Carriage, Model 1917

Adjusting plug for counter recoil buffer.
Clips.
Counter-recoil springs.
Cradle.
Cradle trunnions.
Elevating buffer cylinders.
Elevating nut.
Elevating operating lever.
Elevating screw.
Elevating screw beam.
Elevation speed indicator.
Elevation treadle.
Elevation cranks.
Expansion chamber.
Expansion pipes.
Filling funnel.
Filling valve.
Overflow coupling.
Piston rod nut.

*For 6-inch D. C. Models 1905, 1905 MI, and 1905 MII; and 14-inch D. C. Models 1907 and 1907 MII.

Platforms.	Spring cylinders.
Recoil band.	Spring cylinder heads.
Recoil cylinder drain cock.	Spring rod nut.
Recoil cylinder head	Spring rod piston.
Side frames.	Traversing handwheel

Traversing treadle.

General

Q. Set the gun at a given elevation by the slow motion; at another elevation by quick motion; at another elevation by motor power.

Q. Lay the gun on a given target by means of the sight and traversing mechanism (the instructor having set the deflection); set the gun at a given azimuth.

Q. How is the old packing removed from the stuffing box?

A. First draw all the oil from the cylinders, then with spanner wrench remove the follower and the gland. Remove the old rings of the packing, using the extractor. Examine the old packing and throw away any not fit for use. If any of the old packing is to be used, it should be put in after the new packing.

Q. How is a stuffing box repacked and adjusted?

A. Put on the piston rod one ring of Garlock's Waterproof Hydraulic packing and force it well to the bottom of the stuffing box with a wooden stick and mallet. Treat each layer the same, being careful to break joints, until six rings of new packing have been inserted, or an equal amount of old and new packing, if any of the latter has been used. Place the halves of the gland on the follower, being careful that the halves of the gland do not bind on the screw threads. No more force should be used on the spanner wrench than that of two men, *not using a pipe or any other extension of the wrench handle*; generally that of one man is sufficient.

Q. How can you tell if the stuffing box is properly tightened?

A. There should be about one inch between the flange of the follower and the part into which it is screwed.

Q. What kind of oil is used in the cylinders and how much?

A. Hydrolene. _____gallons.*

Q. What are the throttling bars?

A. They are bars of steel, placed one on each side of each recoil cylinder of a carriage and fastened in place by a line of bolts, the heads of which show along the outside of the cylinder.

* For amount, see table, Appendix E.

The piston head is slotted to receive the bars, which are slightly thinner at the rear than at the forward ends. The depth of the slot does not vary; but as the thickness of the bar, which fits in the slot, does vary, the opening through which the oil can pass from one side of the piston head to the other varies, being larger when the gun is in battery and the thin rear ends of the bars are in the slots, thus keeping the strain from being excessive during the time the gun is recoiling most rapidly. As the gun goes from battery, the opening grows smaller, keeping the oil pressure uniform throughout recoil.

Q. How is the carriage cared for?

A. All parts must be kept clean and free from rust. Rust on the piston rods must not be removed with sand paper, but with kerosene or emery No. 1. The retraction ropes should be oiled with light slushing oil.

Special attention must be given to the following parts:

Gun trunnions, rollers, pintle surfaces, shaft bearings, all sliding surfaces, gun lever axles, bearings, crosshead pieces, elevating racks, elevating band trunnions, crosshead guides, and all elevating, tripping and retracting mechanisms. Traversing rollers and their paths must be clean and well oiled.

Q. What is used as a lubricant for translating rollers?

A. No. 4½ lubricant and graphite.

Q. What kind of oil should be used as a lubricant on breech mechanism, threads of breechblock, breech recess, and gears, and in all oil holes?

A. Engine oil No. 1.

Q. How much oil should be used?

A. Simply enough to cover the surface with a thin coating, rubbed over with the hand. Too much oil is to be avoided, but when firing the guns, use plenty of oil on the breechblock and in breech recess.

Q. What kind of oil should be used in bores of guns and as a lubricant for crosshead guides and traversing and recoil rollers and their paths?

A. Light slushing oil, when fresh.

Q. What other lubricant may be used for traversing rollers?

A. A mixture of engine oil No. 1 and graphite, if light slushing oil is not satisfactory.

Q. What kind of oil will be used as a preservative in case the gun remains unused for a considerable time?

A. Light slushing oil.

Q. How is light slushing oil applied?

A. By means of paint brushes in a light thin coat.

Q. How can light slushing oil be removed?

A. By means of waste or burlap dipped in kerosene oil. Old hydrolene also is suitable.

Q. How is the bore cleaned after firing?

A. By use of water. The bore should be permitted to drain and then be wiped dry before applying light slushing oil.

Q. Explain the adjustment of the grease cups.

A. Be careful that no grit, or dirt, gets into them. Fill them with Lubricant 4½ to the bottom of the bevel at the top of the cup. In putting on the cap be sure that the leather-packed follower enters the cup properly and is not caught nor bent. Screw the cap down until the spring rod projects about ¼ of an inch above the head of the cap. In cold weather, it may be necessary to use a wrench to screw the cap down.

Q. How can you tell when the cup is ready to be refilled?

A. When the cap is screwed well down and the spring rod does not project.

Disappearing carriages only

Q. How is the recoil taken up in a disappearing gun carriage?

A. By the oil in the recoil cylinders,* the inclination of the chassis rail, and the excess counterweight.

Q. What is the object of the movable hand weights?

A. By varying the number used, the gun may be made to go in battery properly. If it strikes the buffers hard, when tripped, take off hand weights. If it fails to go clear in, add weights. Some disappearing carriages have no hand weights, but depend altogether on buffer valves.

Q. How are recoil cylinders filled?

A. Remove filling plugs of both cylinders and fill till they overflow, then replace plugs.

Q. What is the equalizing pipe?

A. A pipe connecting the front ends of the two cylinders.

Q. Why is it necessary?

A. To keep the pressure during recoil the same in the two cylinders and thus keep the carriage from jamming.

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* Disappearing carriages models 1905, and MI and MII, for 6-inch guns, and models 1907 and MI for 14-inch guns, have only one recoil cylinder, which is vertical and moves with the counterweight, the piston rod being secured at its lower end.

Q. What is the connecting pipe?

A. It is a pipe extending back from the equalizing pipe to the throttling valve, by which it is closed.

Q. What are the throttling pipes?

A. Two pipes connecting the throttling valve with the rear ends of the two cylinders.

Q. What is the object of the throttling valve?*

A. Its object is to control the amount of recoil of the gun.

Q. How does the throttling valve control the recoil of the gun?

A. By opening or closing the connecting pipe and thus regulating the flow of oil from the front ends of the cylinders to the rear ends.

Q. What is the effect of closing the throttling valve of the ....-inch carriage by one complete turn?

A. It will lessen the recoil by about ..... notches.

Q. What care must be taken of the throttling valve?

A. It must always be kept clean and free from dirt and must always be locked.

Q. On carriages which have it, what is the combined recoil and buffer valve?

A. It is a double valve like two throttling valves, the recoil valve doing just what a throttling valve does. The buffer valve, by regulating the flow of oil from the rear ends of the cylinders to the front ends, controls the last motion in counter recoil, and indirectly has some effect on recoil. The recoil valve has no effect on counter-recoil.† (See footnote, page 11.)

Q. How are the proper settings of the recoil valve and the buffer valves determined?

A. The recoil valve, by an examination of the records of previous firing; and the buffer valve, by actual trial.

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* In the case of disappearing carriages models 1905 and MI and MII, for 6-inch guns, and models 1907 and MI, for 14-inch guns, the amount of recoil is controlled by a recoil valve contained in the piston rod. The upper end of the rod is bored axially to receive the stem and body of the recoil valve, the action of which is as follows: At the piston head the axial bore is surrounded by two grooves, from each of which radiate four holes, and one set of four holes opens into the cylinder on each side of the piston. Oil can, therefore, pass from one side of the piston to the other in two ways, namely, by the outside of the piston head through the diametral clearance and the throttling grooves, and by the two sets of radial holes. But the passage by the two sets of radial holes is regulated by the recoil valve body, which is a bar fitting closely in the piston rod bore and having a slot cut on its outer surface, which, when the valve is entirely open, extends from one groove to the other. As the valve body is drawn upward, the portion of the slot in the valve body open to the lower groove in the piston rod bore diminishes, so that, at the end of its upward movement, the passage between

12-inch Barbette carriage, Model 1917

Q. How is the recoil taken up?

A. By the oil in the recoil cylinder and by the counter-recoil springs.

Q. How is the gun returned to battery after firing?

A. By the counter-recoil springs.

Q. How is the counter-recoil buffer adjusted?

A. By means of the adjusting plug.

Q. At what elevation must the gun be laid when the recoil cylinder is being filled?

A. At zero degrees elevation.

Q. Show how to fill the recoil cylinder.

Q. Show how to drain the recoil cylinder.

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the two sets of radial holes is closed. The flow of oil being thus regulated by the valve, the recoil of the gun is controlled.

†In the case of disappearing carriages models 1905 and MI and MII, for 6-inch guns, and models 1907 and MI for 14-inch guns, there is a counter-recoil system entirely separate from the recoil system. In this separate system, the buffers are wholly detached from the top-carriage, which comes into contact with them only as it goes into battery, when it strikes the projecting ends of the piston rods, forces them to the front against oil that passes from one side of the pistons to the other through the clearance and through equalizing and throttling pipes, and against springs, which serve, when the gun is from battery, to force the piston rods 9 (or 12) inches to the rear. There is a buffer valve which regulates the flow of oil through the pipes.

(d) POWDERS, PROJECTILES, PRIMERS, AND FUSES*

POWDERS†

Q. What kind of powder is used in guns?

A. Smokeless, nitrocellulose.

Q. What is nitrocellulose?

A. It is nitrated cotton. That is, it is what results when dry cotton is immersed in nitric acid. Water, also, is formed. Sulphuric acid absorbs water, so sulphuric acid is used in the mixture to absorb the water formed and to keep the nitric acid from being diluted.

Q. What are the next steps in making nitrocellulose powder?

A. 1. Washing excess acid from the nitrocellulose.
2. Dissolving the nitrocellulose in a mixture of alcohol and ether.
3. Compressing the material after evaporating the alcohol and ether.
4. Rolling it into sheets or pressing it into rods or tubes.
5. Cutting up the sheets, rods, or tubes into grains.
6. Drying the grains.

Q. What is the form of its grains?

A. Perforated cylinder.

Q. What is the weight of the service charge for a gun of the model and caliber in your battery?

A. ----------lbs.‡

Q. What are *Combustion*, *Ignition*, *Inflammation*, and *Explosion*?

A. *Combustion* is the burning of a grain of powder, or wood, or coal, from the surface of ignition inward or outward, or both.

Ignition is the setting on fire of a part of the grain or charge.

Inflammation is the spread of the ignition from point to point of the grain, or from grain to grain of the charge.

Explosion is rapid combustion. It is the rapid conversion of gunpowder into gases and solids. (When this conversion is very rapid and accompanied by a crashing or shattering effect, it is called *detonation*.)

* See Ordnance pamphlet No. 1872 of 1915.
† See Ordnance pamphlet No. 1888 of 1914.
‡ See Table in Appendix "E" for all models.

Q. What is the object of the igniting charge?

A. To secure a quicker ignition of the smokeless powder.

Q. Where is the igniting charge located?

A. An igniter, or igniting charge, is quilted in each end of each charge, and is also placed in the cloth tube connecting the ends. This tube filled with black powder is called a core igniter.

Q. What kind of powder is used as igniting charge?

A. Black powder.

Q. How is powder stored?

A. In hermetically sealed cases in magazines.

Q. What is the normal muzzle velocity of the gun of the model in your battery, with service charge?

A. _____foot-seconds.*

Q. In 10- and 12-inch guns, will a given powder charge give the same velocity in model 1895 guns as in the Model of 1888?

A. No. 15 foot-seconds less velocity is to be expected in the 1888 models than in an 1895.

Q. Should powder for one caliber gun ever be used in one of a different caliber?

A. No. It is prohibited.

PROJECTILES†

Q. What are the projectiles used in your battery?

A. Armor-piercing shot and shell, capped; cast-iron shot and shell, capped.

Note:—All Deck Piercing Shell and Armor Piercing Shell have been declared obsolete and A. P. Shot will be used in the future for both mortars and guns.

Q. Their weights?

A. Long point_____lbs.* Short point_____lbs.*

Q. What is the difference between shot and shell?

A. The shell is longer than the shot. They weigh the same. While both have cavities inside, yet the cavity in the shell is larger; so the shell carries a larger bursting charge. The walls of the shot are thicker than those of the shell; so the shot has greater strength to penetrate armor without breaking up.

Q. What projectile is used for target practice and why?

* See table in Appendix "E" for all models.

† For instructions for loading, see Appendix "F."

A. A cast-iron projectile of the same shape as an armor-piercing projectile. The cast-iron is cheaper.

Q. What does the color of a projectile indicate?

A. The bursting charge. Yellow indicates high explosive; Red, shrapnel; Black, solid shot or sand loaded shell (target practice projectiles).

Q. How is smoke mixture indicated?

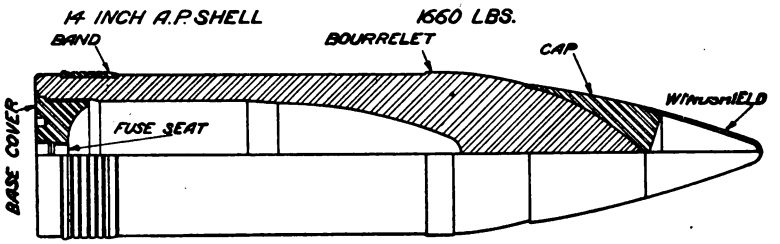
A. By a green band ½ inch wide above the bourrelet.

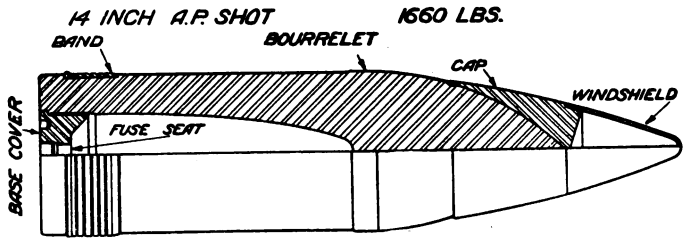
Q. How is semi-steel indicated?

A. By a red band ½ inch wide above the bourrelet (and below the green band if there is one).

Q. What colors are used for stenciling?

A. Black, except that white is used for black surfaces.





Q. What is stenciled on the ogive of A.P. steel shot and shell for guns of 6-inch and greater caliber?

A. *1st line.* Exact weight of loaded shell, as "108."

2nd line. Caliber and type of gun, as "6 S C G ."

3rd line. Kind of explosive, using the abbreviation TNT for Trinitrotoluol, Am. for Amatol, followed by the percentage of mixture, as 80/20 or 50/50; and exp. D., for Explosive D.

4th line. Lot number of filled shell. The ammunition lot number.

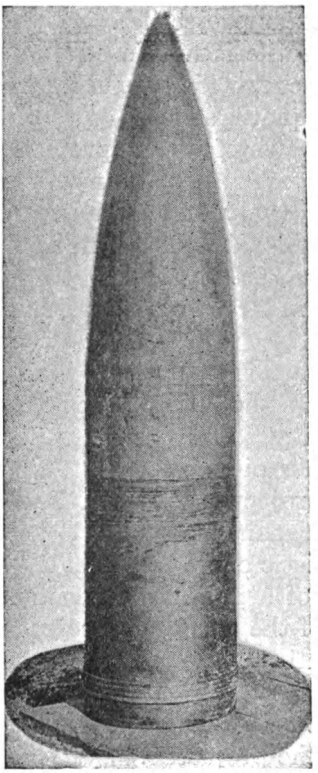
Q. What is stenciled on the center of gravity of A.P. shot and shell for guns of 6-inch and greater caliber?

A. Description of shell, as "Armor Piercing shell Mk. III."

Q. What information is stenciled on T.P. (target practice) projectiles?

A. (a) Exact weight, stenciled on the ogive.

(b) Caliber and type of gun, as "6 SCG," stenciled on the ogive.



12-INCH SHELL WITH NEW MODEL LONG POINTED CAP

12-INCH SHELL WITH OLD MODEL CAP

(c) Description of projectile, stenciled on center of gravity, as "Target Practice Cast Iron Shot."

Q. What information is stamped on the base of projectiles?

A. (a) Caliber and type of gun and mortar.

(b) Kind of shot or shell.

(c) Lot number of unfilled shell.

(d) Weight of shell (unfilled).

(e) Name or initials of machining plant.

(f) Inspection stamps.

A sample marking would be: 12" Mortar D.P. shell 700MkIII Lot 2-12, Bethlehem Steel Co., P.D.V.
Insp. N.S.K.

Q. What information concerning fuses is stamped on the rotating band at the time of manufacture?

A. The mark number and type of fuse to be used, as: "Mk III—Maj. Cal. Fuse." (The letter G or M indicates whether fuse is armed for gun or mortar projectile).

Q. What indicates that the projectile is not fused?

A. Four vertical black stripes 2 inches wide extending from rotating band to base of shell and equally spaced.

Q. What is stencilled on the base cover of a fused projectile?

A. The amount of delay action of the fuse, as "Non-Delay," "Short-Delay," or "Long-Delay," or equivalent initials.

Q. What indicates a projectile which is neither filled nor fused?

A. The word "Empty" stencilled in large letters lengthwise on the projectile.

Q. Using diagram of a projectile, point out the following: The windshield, the armor-piercing cap, the bourrellet, the base cover, the rotating band, the fuse seat.

Q. What is the object of the armor piercing cap?

A. To prevent the point of the projectile from bending or breaking when the projectile strikes against armor.

Q. What is the object of the ballistic cap (windshield)?

A. To give a shape to the head of a projectile which will reduce to a minimum the resistance of the air on the projectile.

Q. What is the object of the rotating band?

A. To give rotation to the projectile and thus prevent it from tumbling in the air, and to act as a seal to prevent the powder gases from escaping around the projectile.

Q. How should projectiles be piled?

A. Projectiles will always be piled on skids, with no weight resting on rotating bands, with point to the wall, and base out so they may be easily inspected and fused in case of necessity.

Projectiles for target practice must never be piled with those intended for service.

Projectiles will be painted as required by regulations, and in case the galleries are wet the projectiles after painting will be slushed. Skids or strips of wood should be placed between layers, and every care taken to prevent injury to rotating bands.

Q. What is the weight and caliber of subcaliber projectiles for guns?

A. Weight, 1.1 pounds. Caliber, 1.46 inches.

Q. What is the name of the explosive used in all our armor piercing projectiles?

A. Explosive D.

Q. What is the appearance of explosive D?

A. It is a dark yellow, or orange color, powder.

Q. How is it loaded in the projectile?

A. By hand, using suitable ramming tools.

FUSES*

Q. What is a fuse?

A. A fuse is the device used to ignite the bursting charge of a projectile at any point of its flight, or upon impact.

Q. What is the difference in purpose between a fuse and a primer?

A. A fuse ignites the bursting charge in the projectile; a primer ignites the propelling charge in the gun or mortar.

Q. How are fuses classified according to their types?

A. According to method of arming:

Ring resistance.
Centrifugal.

According to method of operation:

Combination time and percussion.
Detonating.

According to location in the projectile:

Point.
Base.

Q. What class is used in armor piercing projectiles?

A. The base detonating fuse.

Q. What base detonating fuses are used in armor piercing projectiles for 8, 10, 12, and 14-inch seacoast guns?

A. (1) The major caliber base detonating fuse; (2) The armor piercing base detonating fuse.

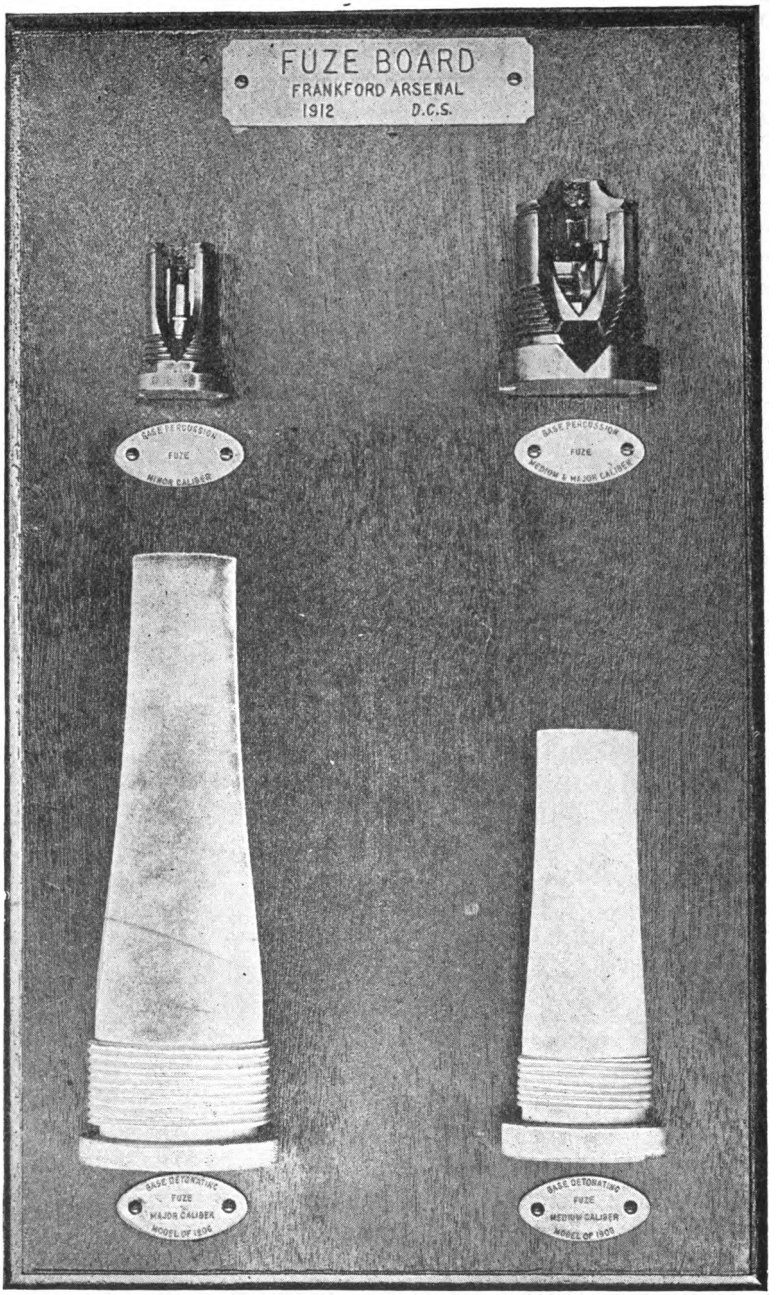
Q. Of these two which is the later model?

A. The major caliber base detonating fuse. (See "Fuse Board, Frankford Arsenal, 1912.")

Q. What is intended as to future supply of the other one?

A. No more will be issued after the present supply has been used up.

* See Ordnance pamphlets No. 1727 (latest revision, 1913) and 1872 (latest revision, 1915); see also "Fuze Board, Frankford Arsenal, 1912."



Department of Enlisted Specialists, C. A. S.

Q. In A. P. *shot* for 8, 10, 12, and 14-inch guns which fuse is used?

A. The major caliber base detonating delay action fuse.

Q. In A. P. *shell* for 8, 10, 12, and 14-inch guns which fuses are used?

A. Either the non-delay action major caliber b.d.f. or the non-delay action A.P. b.d.f., *depending on the lot number of the shell.*

Q. How can you tell from the lot number whether a projectile has a delay or a non-delay action fuse?

A. Those having delay action fuses are odd numbered; those having non-delay action fuses are even numbered.

Q. What plunger is used in all A.P. and D.P. projectiles in service?

A. The Semple centrifugal plunger.

Q. In what respect do the plungers used in the major caliber base detonating fuse and the A.P. detonating fuse for A.P. shot and shell for guns differ from the plungers used in fuses of the same types for D.P. shell for mortars?

A. The Semple centrifugal plungers of the fuses for use in guns are designed to arm at 2000 revolutions per minute, while those for use in mortars are designed to arm at 1300 r.p.m.

Q. What are the lengths of the two fuses used in projectiles for 8, 10, 12, and 14-inch guns?

A. (1) The major caliber base detonating fuse, 6.7 inches; (2) The armor piercing base detonating fuse, 9.35 inches.

Q. What is the purpose of the plug in a base detonating fuse?

A. To fill the seat in which, before use, is inserted the plunger.

Q. What base detonating fuses are used in armor piercing projectiles for 5 and 6-inch seacoast guns?

A. (1) The medium caliber base detonating fuse; (2) The siege (base) detonating fuse.

Q. Of these two which is the later model?

A. The medium caliber base detonating fuse. (See "Fuse Board, Frankford Arsenal, 1912.")

Q. What is intended as to the future supply of the other one?

A. No more will be issued after the present supply has been used up.

Q. In A.P. *shot* for 5 and 6-inch guns which fuse is used?

A. The medium caliber base detonating delay action fuse, except in Armstrong shot, in which will be used the non-delay action fuse.

Q. In A.P. *shell* for 5 and 6-inch guns which fuses are used?

A. Either the non-delay action medium caliber b.d.f. or the non-delay action siege (base) d.f., *depending on the lot number of the shell.*

Q. What are the lengths of the two fuses used in projectiles for 5 and 6-inch guns?

A. (1) The medium caliber base detonating fuse, 4.75 inches; (2) the siege (base) detonating fuse, 6.6 inches.

Q. How do you make a tight joint in assembling a fuse in a projectile?

A. Vaseline is placed in the threads of the fuse hole and on the threads of the fuse and screwed up tight. As an additional precaution a base cover is added.

NOTE.—The work of inserting fuses in projectiles is exceedingly dangerous and should be done strictly in accordance with "Instructions for Loading Projectiles." (See Appendix "F.")

Q. What is the object of the tight joint, and of the base cover?

A. To prevent premature explosion of the bursting charge by gases entering from the propelling charge on explosion of latter.

PRIMERS*

Q. What is a primer?

A. A primer is a device used to ignite the powder charge in the gun.

Q. Name the classes of primers.

A. 1. Drill.
2. Friction, Model 1914.
3. Simple electric.
4. Combination electric-friction.
5. Percussion.
6. Igniting.

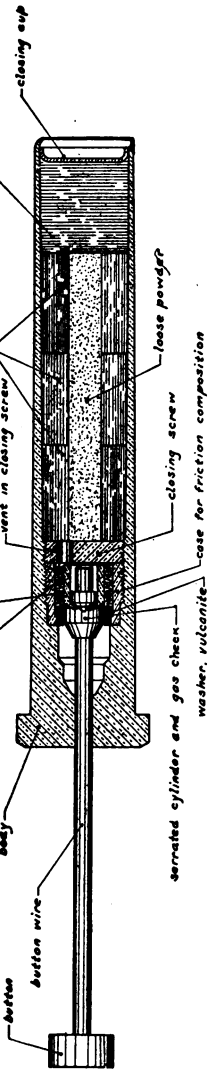
Q. What primers do you use at your battery?

A. Drill primer, friction, simple electric, combination electric-friction primer, and 20-grain igniting primer.

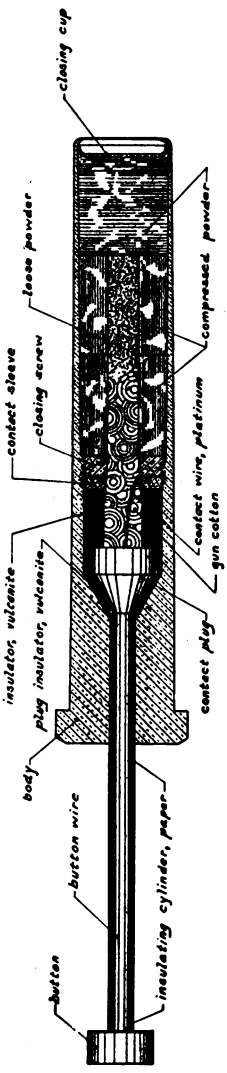
Q. When is each used?

* See Ordnance pamphlet No. 1881 (newest edition, 1915; see also "Primer Board, Frankford Arsenal, 1912."

FRICTION PRIMER

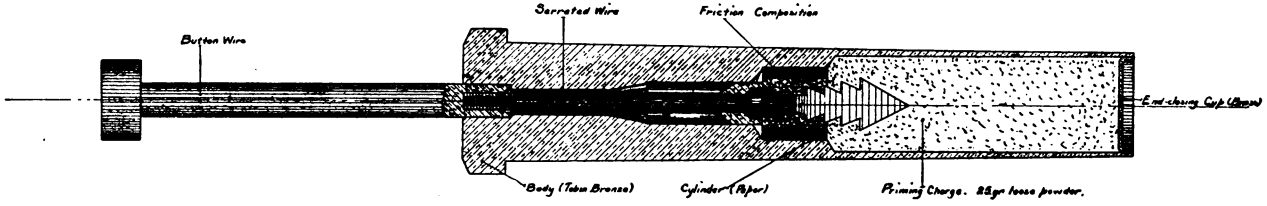


ELECTRIC PRIMER



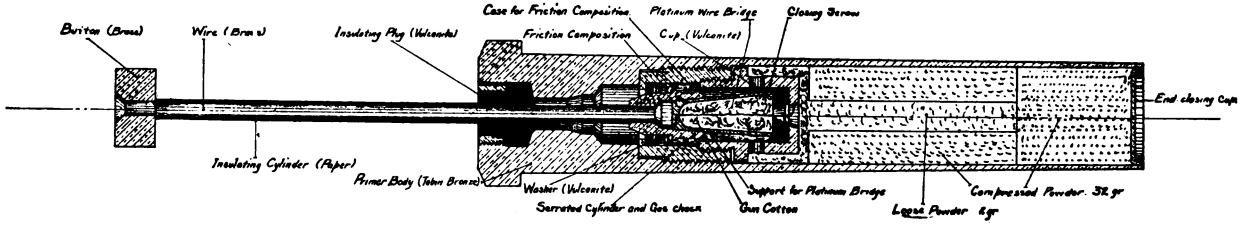
DRILL - PRIMER

- FRICTION -



COMBINATION - PRIMER

ELECTRIC - FRICTION



A. The drill primer is used in drill and in sub-caliber practice; the simple electric primer and the friction primer in service practice and in action; the combination electric-friction primer in subcaliber practice; and the 20-grain igniting primer in the base of the subcaliber ammunition.

Q. Where is the percussion primer used?

A. In fixed ammunition, such as for small arms and the 3-inch gun.

Q. Why are drill primers furnished in addition to combination primers and friction primers Model 1914?

A. The drill primer is much cheaper and can be loaded at post.

Q. What happens when the wire of the primer is pulled to the rear by the lanyard?

A. The teeth at the inner end are pulled through the friction composition. This makes enough heat to ignite the composition and the flame from this ignites the priming charge of loose powder which fires the igniting charge in the gun.

Q. What happens when electricity is sent through an electric primer?

A. The electricity going through the fine platinum wire heats it until it is hot enough to ignite the gun cotton around it, then the flame from this cotton ignites the priming charge of loose powder which then fires the igniting charge in the gun.

Q. When a primer fails and is rejected, what should be done?

A. The wire should be bent through an angle of 180 degrees to prevent the primer being used again.

(e) CORDAGE, BLOCKS, GINS, SHEARS, AND JACKS

CORDAGE

Q. Define yarn, strands, jaws of a rope.

A. A yarn is a thread of hemp or other fibrous material.

A strand is a number of yarns twisted together.

The jaws are the spaces between the strands of a rope.

Q. Make a square knot; bowline; anchor knot; rolling hitch; blackwall hitch; round turn and two half hitches; clove hitch; long splice; short splice. Explain the use of each.

A. Square knot, for joining the ends of two ropes of the same size. (Note.—If the pull is on diagonal corners, this knot readily slips and is called a *thief knot.*)

Bowline, for forming a loop at the end of a rope which will neither draw up, become loose, nor jam when wet or under heavy strain.

Anchor knot, for fastening a rope to an anchor or ring. It will neither draw up, become loose, nor jam when wet or under a heavy strain.

Rolling hitch, for fastening a rope to a strap or tail block, and to secure a fall while being shifted on a windlass or capstan.

Blackwall hitch, for fastening a rope to the hook of a block. Round turn and two half hitches, to secure guys to stakes. Clove hitch, for fastening a rope to a spar.

Long splice, for splicing a rope without increasing its diameter at the place of splice.

Short splice, for splicing a rope allowing an increase in diameter at the place of splice.

Q. How is rope stored?

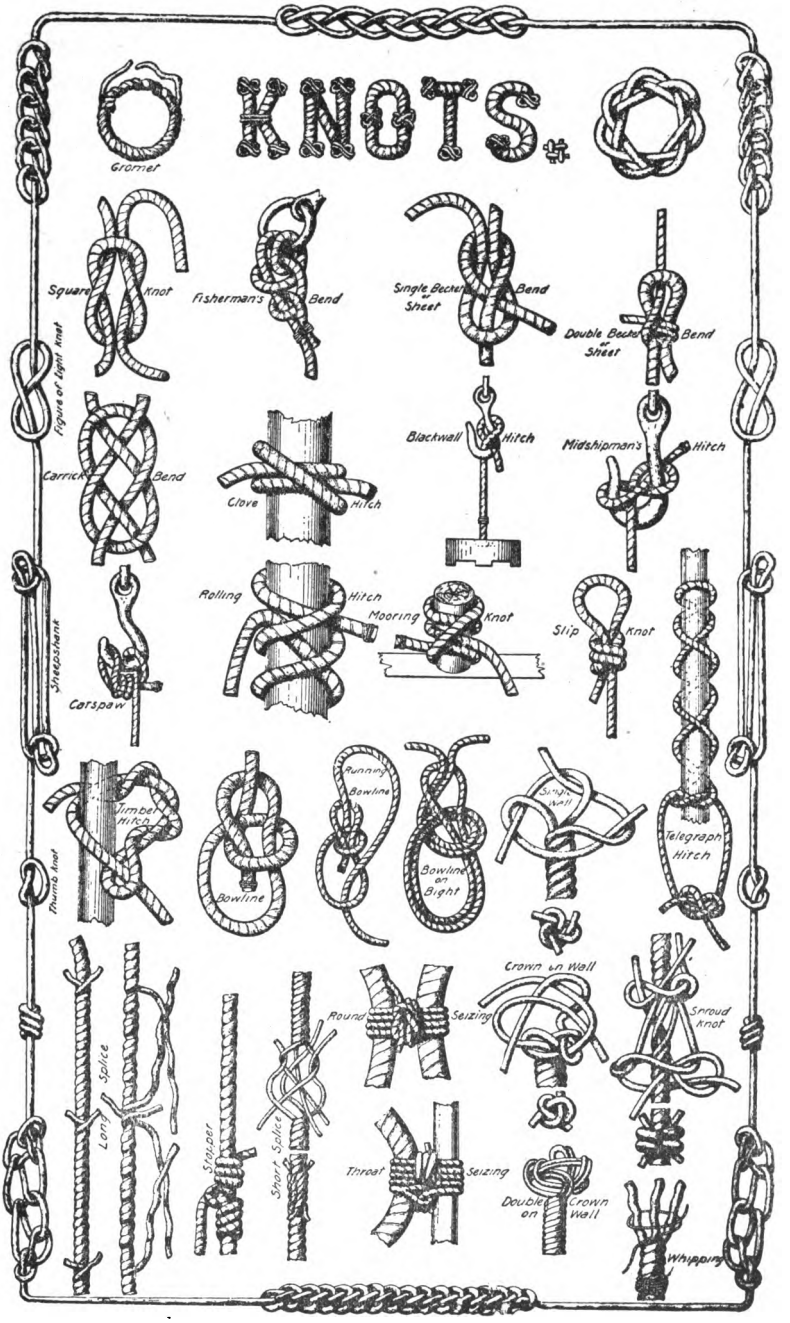
A. Rope should be stored in a dry cool place and in such a manner as to allow a free circulation of air through its coils.

Q. After being used, how is rope treated before storing?

A. It should be thoroughly dried, carefully examined for any evidence of chafing or deterioration, and, if practicable, all sections dangerously weakened should be cut out and the rope spliced at these places.

Q. What is whipping?

A. Wrapping the end of a rope with twine to prevent its unraveling.



Q. What is splicing?

A. Joining the ends of ropes by intertwining the strands.

Q. What is worming?

A. Filling the jaws of a rope by laying spun yarn or marline along them, to render the surface smooth for parceling and serving.

Q. What is parceling?

A. Wrapping (with the lay of the rope) with narrow strips of canvas so as to protect a rope.

Q. How do you serve a rope?

A. By worming, then parceling, and finally laying on spun yarn or other small stuff around the rope in turns close together against the lay of the rope.

Q. What is a strap, or sling, and for what is it used?

A. It is formed by knotting or splicing together the ends of a short rope. It is used for hooking tackles into.

Q. Mouse a hook and explain its purpose.

A. It is seizing placed around the jaw of a hook to prevent it from spreading or unhooking.

BLOCKS

Q. Name the different parts of a block and point them out.

A. Shell, sheave, pin, strap, eye, thimble, hook, bolt.

Q. Mention the different kinds of blocks.

A. Single, double, treble; snatch, and tail blocks.

Q. What is a purchase?

A. A purchase in cordage is a tackle of any kind for giving power.

Q. What is a tackle?

A. It is a purchase formed by rigging a rope through one or more blocks.

Q. Point out the running part, the standing part, and the fall.

Q. Reeve the following: Whip, gun tackle, luff.

A. See illustration (page 20).

Q. What is meant by the power of a tackle?

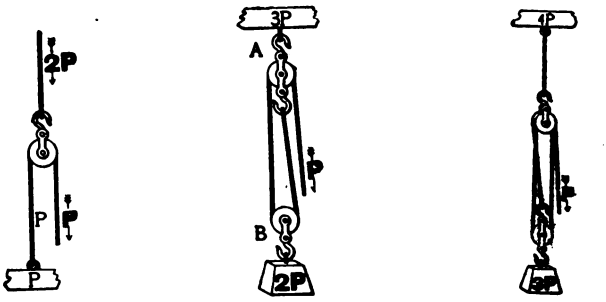
A. The number obtained by dividing the weight raised by the force applied on the fall necessary to balance the weight. In an ordinary tackle the number of ropes pulling upon the movable block is the "power."

Q. Examine a triplex block and explain its use.

A. A triplex block is a device used to lift a heavy weight with the use of a small amount of power.

For many purposes it is much better than any form of tackle.

It consists of a train of gears operated by a large wheel over which passes a light chain. Power is applied to this chain. The gears operate a small wheel or sprocket, over which runs a heavy chain. The heavy chain raises the weight. A hook is bolted to one side of the casing for attaching the block to a crane or davit.



WHIP TACKLE GUN TACKLE LUFF TACKLE

GINS

Q. Describe a gin.

A. A gin is a tripod formed of three poles. The two outside ones are called legs, the third one the pry pole. A gin requires no guys.

Q. What is it used for?

A. For lifting weights *vertically.*

Q. Name the different parts of a garrison gin.

A. Two legs, pry pole, bolt and clevis, windlass and ratchet, two hand spikes, three shoes, two braces, and tackle.

Q. How much can be safely lifted with it?

A. 17,000 pounds.

Q. Explain briefly how it is assembled and raised.

A. The legs and pry pole are laid on the ground with the heads together and in a position for assembling.

The head is then assembled by putting the pin through the pry pole, clevis, and legs. The windlass is put in place and the braces are brought up and put in their places.

The gin is raised, after being put together, by raising the head and bringing up the foot of the pry pole towards the feet of the other two legs.

Q. How can the upper block be placed in position after the gin has been raised.

A. By rigging a trace rope through the clevis of the gin and shell of the block and hoisting it up.

Q. What are the principal uses of the garrison gin?

A. For lifting vertically any weights within its capacity. It is designed especially for use around the gun and mortar emplacements.

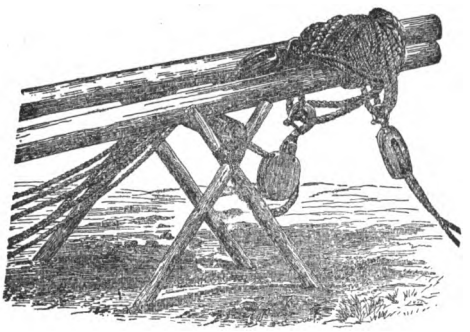
SHEARS

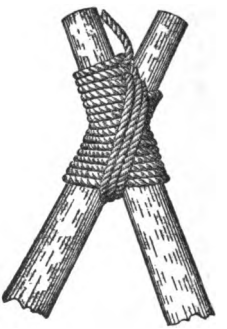
Q. Describe shears.

A. Shears consist of two spars, of a size suitable for the weight to be raised, lashed together at the cross. A tackle is fastened to the lashing by a strap or otherwise; the hook is moused; and holdfasts are required.

Q. What are shears used for?

A. Shears are used for lifting heavy weights to move them a short distance, as in loading or unloading a ship or railroad car.





SHEAR LASHING

(SEE ENGINEER FIELD MANUAL. FIGS. 78 AND 79. BRIDGES)

Q. How is a shear lashing made?

A. The two spars for the shears are laid along side of each other with their butts on the ground, the points below where the lashing is to be resting on a skid. A clove hitch is made around one spar and the lashing is taken loosely eight or nine times about the spars above it without riding. A couple of frapping turns are then taken between the spars and the lashing is finished off with a clove hitch above the turns on one of the spars. The butts of the spars are then separated, a sling (or strap) is passed over the fork, to which the block is hooked or lashed, and fore and rear guys are made fast with clove hitches to both spars just above the fork.

Prepare the holdfasts for the foot ropes, to prevent the heels from slipping while raising, and for the guy ropes when the shears are ready for raising.

Q. How are shears held in position after being raised?

A. By means of guys.

Q. How are the shears raised?

A. If not too heavy, lift the head and haul in on the proper guys. If too heavy to raise in this way, form a crutch by lashing together two poles near their upper ends, the feet of the crutch being slightly in rear of the heels of the shears and secured to prevent them from slipping. Lay the rear guy over the crutch and raise the crutch by means of two light guy ropes, until it is inclined at an angle of about 45° to the front. Haul on the rear shear guy, allowing the crutch to rise as the shears rise. After the shears are raised high enough so that the crutch ceases to act, it is lowered by means of its guy ropes.

HYDRAULIC JACKS

Q. For what is a hydraulic jack used?

A. For lifting heavy weights.

Q. What liquids are used in the jack?

A. Alcohol (*not wood alcohol*) one part and water two parts, for the base jack; and for the horizontal jack, one part of alcohol and one part of water.

In each case a tablespoonful of sperm oil is added.

Q. How is the jack filled?

A. After cleaning, fill through the large hole, replace hexagonal cap, and then the lowering valve. In case it is necessary to add a little liquid to replace that which has leaked out, and at the place of work, remove small screw, fill, and replace the screw. This is to prevent sand from entering the pump mechanism. The ram should be down in both operations.

Q. How is the jack emptied?

A. With the ram down, place the finger over the escape hole in the cylinder, pump the ram until the bottom of it is above the hole, then open lowering valve, remove the finger, and allow the air to enter under the ram. The ram can now be easily pulled out.

Remove the lowering valve and hexagonal cap and invert jack to allow liquid to run out.

NOTE.—If the jack has lowering valve near bottom, only the cap need be removed.

Caution.—Always insert the lever in the socket with the projection down.

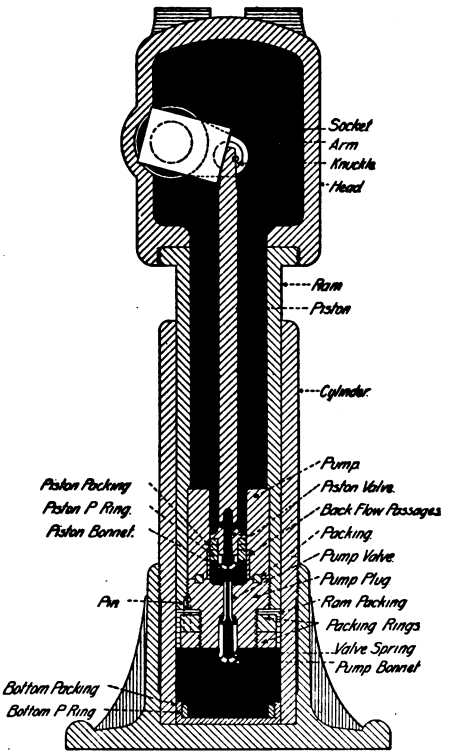
Q. How is a jack cared for when not in use?

A. The jack should always be kept filled and clean and

free from rust. The ram should be kept down. Never fill with water, kerosene, or wood alcohol, which cause it to rust.

Q. Show how a jack is used in moving a heavy weight.

A. See that the bottom of the jack has a firm bearing surface, and that the top of the ram presses securely against the weight to be moved. Tighten the lowering valve, and work the handle with a slow, steady stroke, and follow the weight up closely with the blocking.



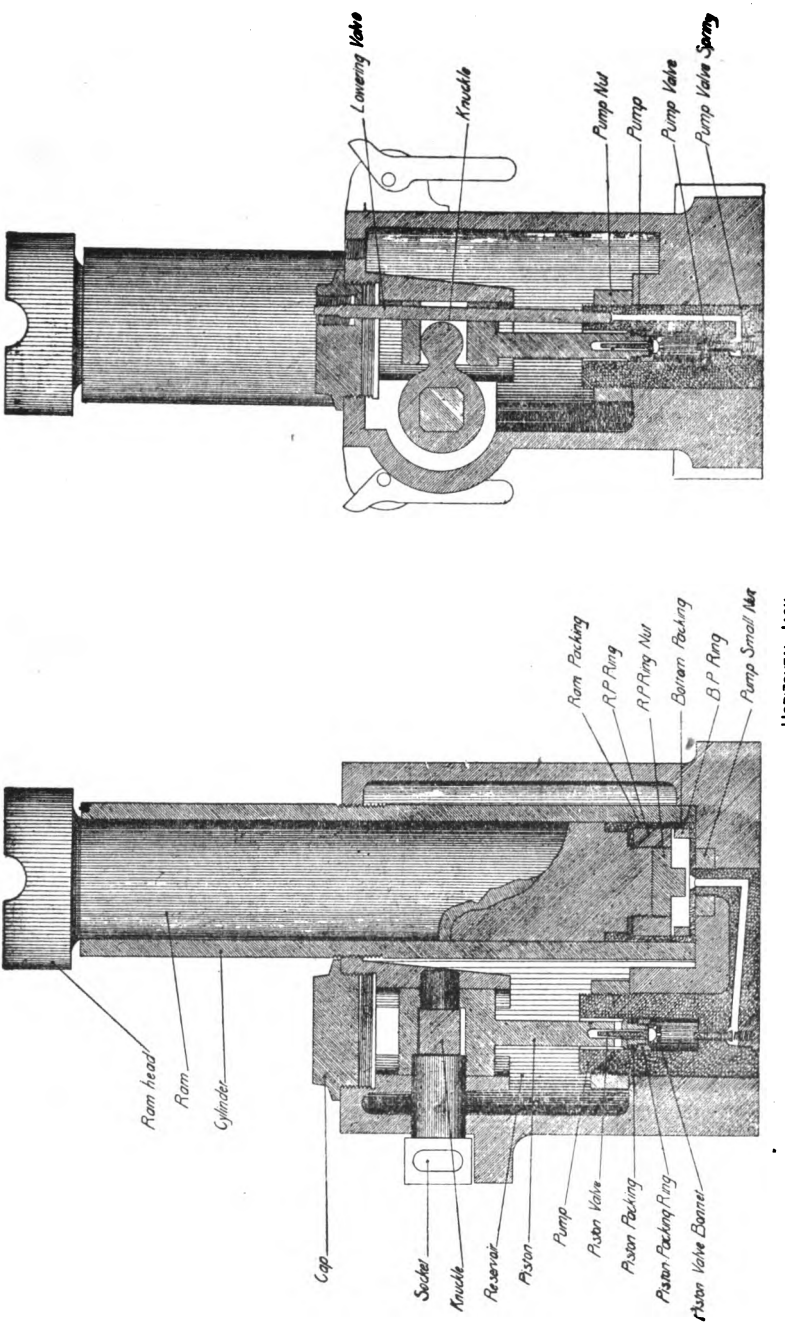
BASE JACK

Q. What is the difference, if any, in the use of a base and a horizontal jack?

A. A horizontal jack may be used equally well in a horizontal or an upright position. A base jack may be used standing or at an angle, with the limitation that the head must be a little higher than the foot, so that the pump will be always submerged.

Q. How is a heavy weight lowered with a jack?

A. Care must be taken not to let the ram down too fast



HORIZONTAL JACK

nor to check it too suddenly. Loosen lowering valve very slowly, bearing in mind that to avoid accident the weight must be "followed down" with blocking.

Q. How is a claw used with a jack?

A. When it is impossible to get the head of the jack under the weight, a claw is used. One end is placed under the object to be raised and the other end of the claw over the head of the jack.

(f) U. S. MAGAZINE RIFLE

Q. Point out the following parts:

Barrel.	Firing pin sleeve.
Front sight.	Striker.
Stacking swivel.	Main spring.
Stock.	Extractor.
Upper band.	Safety lock.
Lower band swivel.	Cut-off.
Grasping groove.	Cocking piece.
Hand guard.	Ejector.
Rear sight.	Magazine.
Movable base.	Floor plate.
Windage screw.	Guard.
Windage scale.	Trigger.
Drift slide.	Lower band.
Slide.	Butt swivel.
Slide screw.	Butt plate.
Range scale.	Bayonet.
Bolt.	Bayonet guard.
Bolt handle.	Bayonet grip.
Locking lug.	Bayonet catch.
Sleeve.	Oiler and thong case.
Firing pin.	Brush and thong.

Q. Describe the bullet for ball cartridge.

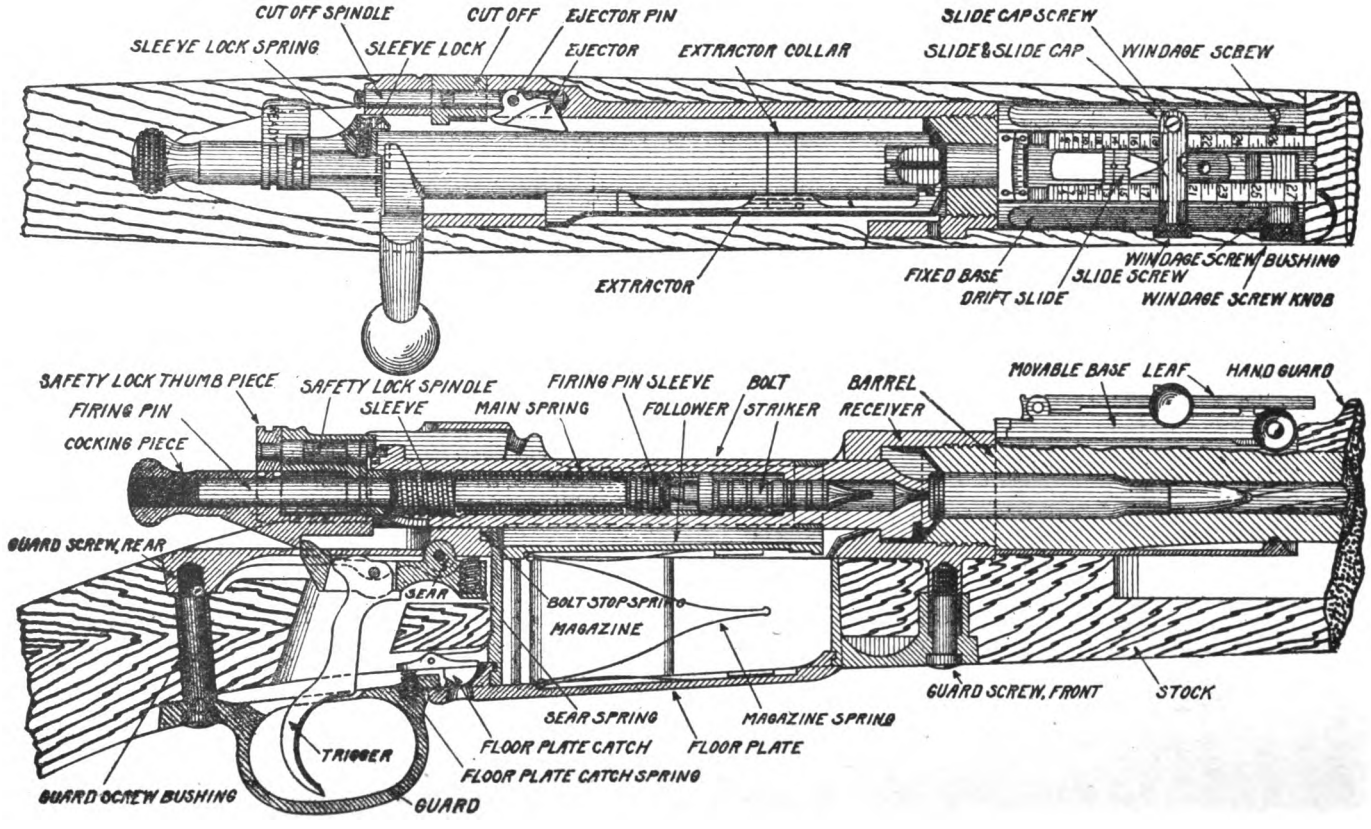
A. It has a core of lead and tin composition inclosed in a jacket of cupro-nickel. The point is very sharp so as to offer little resistance to the air.

Q. Describe the bullet for the old style blank cartridge.

A. The bullet is of paper, hollow, and contains a charge of smokeless powder, which insures the breaking up of the bullet on leaving the bore.

Q. Describe the bullets for the dummy and guard cartridges.

A. The same as the bullet for the ball cartridge. To distinguish it from the ball cartridge, the dummy cartridge has a tinned case provided with six long straight grooves along it and three holes through it. The guard cartridge is distinguished from the ball cartridge by having either 5 grooves



around the case (old style), or six short straight grooves at the shoulder (new style).

Q. What is the shortest range at which dummy ammunition should be used against persons?

A. It is prohibited to fire at persons within 100 yards.

Q. What is the muzzle velocity of the guard cartridge?

A. 1200 f. s.

Q. How should you aim when firing guard cartridges?

A. Use the battle sight and aim at the hips.

Q. What is the muzzle velocity of the ball cartridge?

A. 2700 f. s.

Q. Illustrate to the instructor how you would set the sight for a given range, using both open and peep sights.

Q. Describe the half sight.

A. The top of the front sight is even with the top of the rear sight, and the front sight is in the middle of the rear sight notch.

Q. Describe the peep sight.

A. The top of the front sight is in the center of the peep.

Q. Adjust the sling for firing.

Q. In firing at a vertical target what is the rule for correcting your fire?

A. Square the hundreds in the range. The result is the number of inches on the target that the next shot will strike above (or below) if the rear sight is raised (or lowered) 100 yards.

Q. To apply the rule: If a well aimed shot strikes the width of the bulls-eye below the bull at 300 yards, how much should you raise the rear sight for the next shot?

A. The bulls-eye is 8 inches in diameter. Therefore the shot struck $4+8$ inches below the center of the bull. I want to raise the point struck 12 inches. At 300 yards, $3\times3=9$ inches. Raising my rear sight 100 yards will raise the point struck 9 inches. I would therefore add about 130 yards on my rear sight.

Q. At 200 yards, how much will adding 100 yards on the rear sight raise the point struck by the next shot?

A. $2\times2=4$ inches.

Q. To shoot to the right (or left), which way would you move the sight?

A. To shoot to the right move the movable base of the sight to the right; to shoot to the left, move the movable base of the sight to the left.

Q. How much does one point on the windage scale correct for?

A. Slightly over 4 inches for every 100 yards of range; so at 300 yards range one point corrects for about 13 inches.

Q. What is the range of battle sight?

A. About 550 yards.

Q. In firing with battle sight, how high is the trajectory above the line of sight at 200 yards?

A. 2¼ feet.

Q. At 300 yards?

A. 2½ feet.

Q. How do you aim in using battle sight at less than 550 yards?

A. Aim at the earth just beneath the target or at the lower edge of the target.

Q. What oils can be used on rifles?

A. For metallic surfaces: sperm oil, cosmic, or other oil approved by the Ordnance Department; when arms are stored, cosmic should be used. For the stock: raw linseed oil; when in the field, the stock should be wiped off occasionally with a cloth moistened with any of the oils enumerated above.

Q. How far does the rifle shoot?

A. About 5400 yards, or a little over 3 miles.

Q. Where are the rifles made?

A. At Springfield Armory, Mass., and at Rock Island Arsenal, Ill.

Q. What is the cost of the rifle?

A. About fifteen dollars.

Q. What is the cost of the service ammunition?

A. About 27 dollars per thousand.

Q. What is the weight of the rifle?

A. About 8¾ pounds.

Q. What is the length of the rifle?

A. About 43 inches.

Q. What does the letter "U" mean on the upper band?

A. If the band is taken off it should be put back with the "U" up, for the band is tapered to fit the barrel and stock.

Q. Through which end of the bore should the cleaning rod be inserted?

A. Always from the breech end; many rifles have been ruined by having the lands worn down at the muzzle by the cleaning rod.

Q. How is the sling cleaned?

A. First wash with a sponge well lathered with castile soap. When partially dry, rub with a lather of harness soap. When nearly dry, rub with a dry cloth to a polish. Dry in a cool place. Never dry leather in the sun.

FIRST CLASS

AZIMUTH INSTRUMENT

Q. What is the name of this instrument?

A. The Warner and Swasey Azimuth Instrument, Model 1900 (or 1910).

Q. Define an angle.

A. An angle is the difference in direction of two straight lines that meet or would meet if sufficiently prolonged.

Q. Draw with chalk, or pencil, an example.

Q. What is a vertical line? Give an example of a vertical line.

A. A line that runs straight up and down; for example, a plumb-bob line.

Q. What is a horizontal line?

A. One that is perpendicular to a vertical line; or, the axis of the spirit level, when bubble is centered.

Q. What is a plane?

A. That which has length and breadth but no thickness.

Q. What is a vertical plane?

A. One containing a vertical line.

Q. What is a horizontal plane?

A. One perpendicular to a vertical plane.

Q. Define a horizontal plane.

Q. Define a horizontal angle.

A. A horizontal angle is one included between two lines lying in the same horizontal plane.

Q. What is a vertical angle?

A. A vertical angle is one included between two lines lying in the same vertical plane.

Q. What kind of angles are measured by the azimuth instrument?

A. Horizontal angles.

Q. How is the instrument graduated to read?

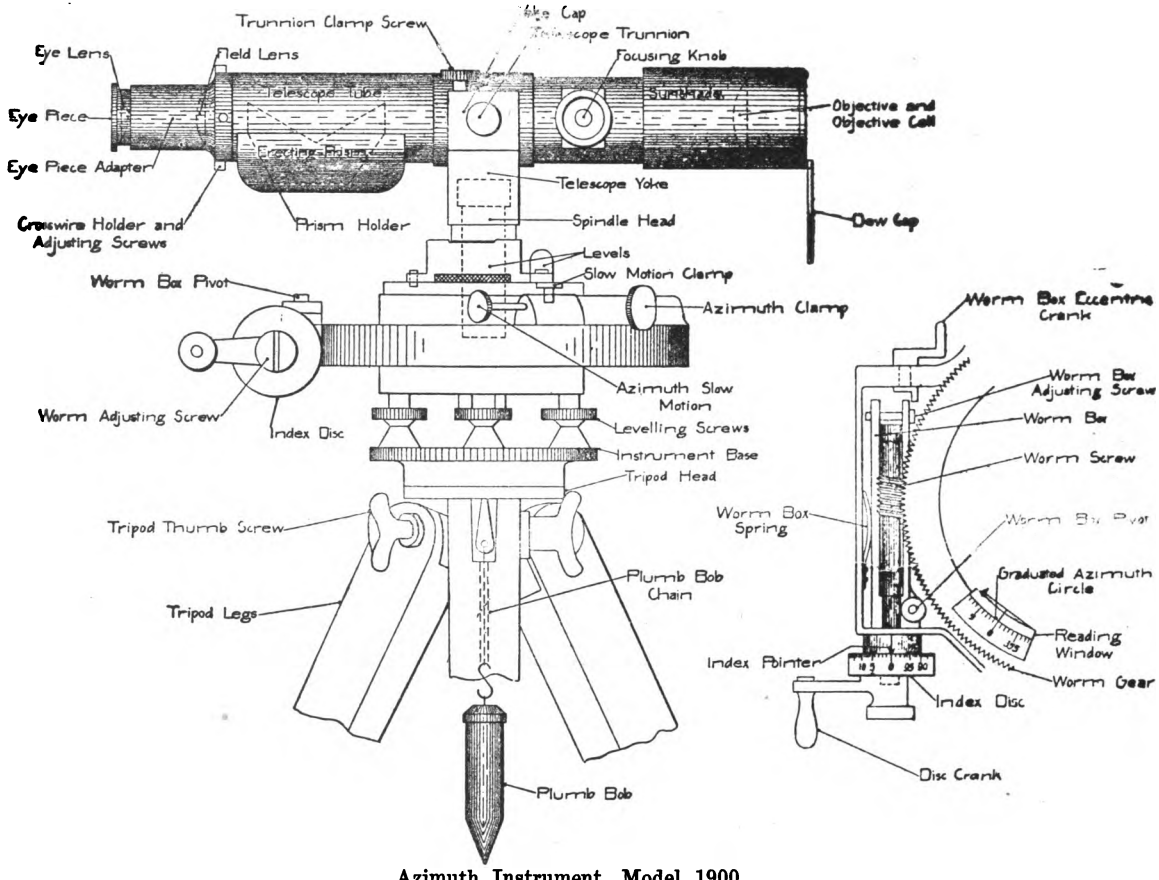
A. In degrees and hundredths of a degree.

Q. Where are the degrees read?

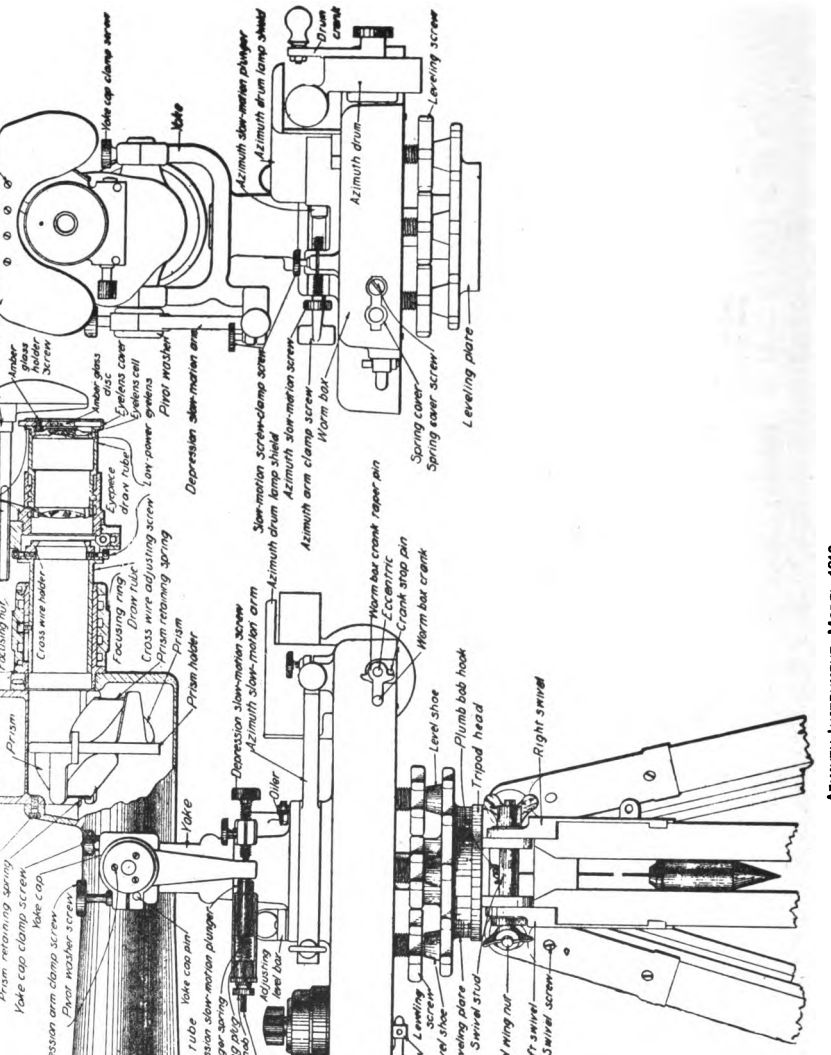
A. On the graduated limb.

Q. What is the value of a space on the limb?

A. One degree.



Azimuth Instrument, Model 1900



AZIMUTH INSTRUMENT, MODEL 1910

Q. Where are the hundredths of a degree read?

A. On the graduated index disc.

Q. What is the value of one space on the index disc?

A. One one-hundredth of a degree.

Q. What is meant by orienting the instrument?

A. It means adjusting the instrument so that it will read correct azimuths.

Q. What is an azimuth?

A. It is a horizontal angle measured from the south point (which is zero) of a north and south line, in a clockwise direction, to a line joining the target and instrument.

Q. Describe how to level and orient the azimuth instrument.

A. The instrument is said to be oriented when it is set up so that it will read azimuths. The operation is as follows:

1. Set the graduated circle and index disc to read the azimuth of a known datum point.

2. Make sure the azimuth slow motion screw is about the middle of its play; then, with the azimuth clamp screw loosened, set the eyepiece slightly to the left of the reading window and clamp the azimuth clamp.

3. Raise the whole instrument by grasping the top (*not the telescope*) and turn it so that the telescope points in the general direction of the datum point with the plumb bob over the home station. In orienting the Model 1900 instrument on a pier mount, the instrument may be turned in the proper direction by loosening all of the leveling screws.

(Second and third are not essential to the reading of azimuths, but are provided so that when the adjustment is complete the parts of the instrument will be in the most convenient relative position for operation and reading.)

4. Level the instrument. See that all the screws have a uniform and firm bearing on the leveling plate; turn the worm box eccentric crank so that the worm is released; set one of the levels exactly over two opposite leveling screws, then turn these two screws either both inward or both outward until the bubble comes in the center, being careful to maintain a firm bearing of the screws on the plate. Then perform the same operation with respect to the other two leveling screws. (The bubble moves in the direction of the left thumb in screwing the leveling screws.) Turn the instrument through 180 degrees and if the bubble does not remain in the center, correct one-half of any variation of either bubble by the ad-

justing screws on the level, the other half by the corresponding level screws. Repeat this operation until the bubbles remain in the middle of the tubes for any position of the telescope in azimuth.

5. Focus the eyepiece until every roughness on the cross-wires is seen.

Then turn the telescope on some distant object and focus the objective by means of the focussing knob until the vertical wire remains on the same point of the distant object, when the eye is moved to right and left. If the object appears indistinct when the parallax is removed, refocus the eyepiece and objective (changing a little each time) until the object is seen clearly.

6. Bring the vertical wire of the telescope approximately on the datum point; having set on the azimuth circle and index disc the azimuth of this point; tighten the azimuth clamp, and, using the azimuth slow motion screw, bring the vertical wire exactly on the datum point. Clamp the slow motion screw.

Q. How is back-lash eliminated?

A. Adjust the *worm box adjusting screw* so that there is no play between the worm and the worm gear; adjust the *worm adjusting screw* till there is no longitudinal play of the worm in its box. The disc crank should turn freely—neither too tight nor too loose.

Q. Set up, under direction of the instructor, the azimuth instrument over a given point; level, orient, and focus it.

Q. Direct instrument on five successive points (whose azimuths the instructor has previously determined) and read the instrument.

Q. What precautions must be observed in caring for this instrument?

A. Never touch the lenses with the fingers.

Clean the lenses only with soft linen or "optical paper," making sure there is no grit on the linen or paper.

Do not jar the instrument, as a jar may cause the prisms to slip.

Protect the instrument from dust and moisture.

Do not turn the leveling screws as hard as you can.

(b) DUTIES IN THE PLOTTING ROOM

I. MANNING PARTY AND APPARATUS

Q. Name the members of the plotting room manning party.

A. *Plotter*, who plots the course of the target on plotting board and has general charge of work in plotting room.

No. 1, *assistant plotter.* Stationed at gun arm center to assist plotter and to operate the wind component indicator.

No. 2, *primary arm setter*, and

No. 3. *secondary arm setter*, who set off azimuth and ranges sent from the observing stations using either primary arm, secondary arm, or gun arm.

No. 4, *range-board operator*, who operates range board and the atmosphere slide.

No. 5, *deflection-board operator*, who operates deflection board.

No. 6, *range transmitter*, who operates device for transmitting information to the guns.

No. 7, operator for telephone to the emergency station.

(At some batteries a different number of men are used or their duties are changed.)

Q. Name the apparatus used in the plotting room.

A. Plotting board.
Range correction board.
Atmosphere and powder slide rule.
Deflection board.
Wind component-indicator.
Device for measuring travel and plotting set-forward point.
Velocity graphic chart.
Telephones to B′, B″, and guns; and mechanical or electrical device for sending information to guns.

Q. What are reference numbers?

A. The numbers of the graduations of some scales of computing and correcting instruments employed in gunnery.

Q. What is the purpose of reference numbers?

A. To avoid the liability to error that comes from the use of "right" and "left" in deflection corrections and of "plus" and "minus" in range corrections.

Q. Do they indicate percentages, miles per hour, yards, etc.?

A. No.

Q. What do they indicate?

A. They indicate settings determined on one instrument (such as the atmosphere and powder slide rule) which are to be applied to the scale of another instrument (such as the range board).

Q. Why are they called reference numbers?

A. Because they *refer* results obtained on one instrument to another instrument by means of *numbers* that are the same on the scales of both instruments.

II. THE PLOTTING BOARD

Q. Point out the following:

Primary station, B′ (B prime).
Secondary station, B″ (B second).
Primary arm.
Secondary arm.
Directing point.
Gun arm.
Coupler.
Base line arm (with scales and veruiers).
Base line.
Azimuth correction scale (used in Case III).
Tally dials.
Range correction scale (no longer used, except in setting gun arm for subcaliber practice).
Azimuth circles (primary, secondary, and gun).
Subcaliber range scale.
Diagonal scale of azimuths.

Q. What is the directing point of a battery?

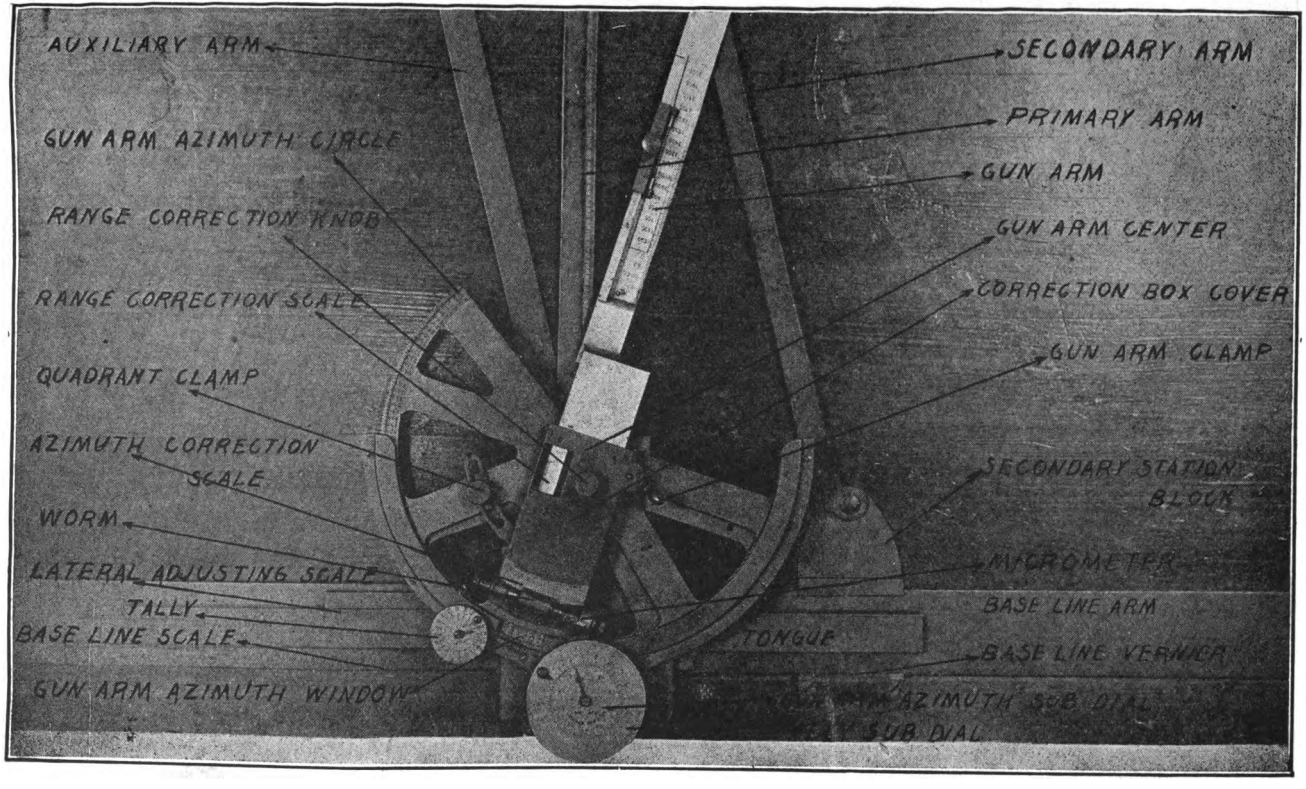
A. A point at or near the battery for which relocation is made in the plotting room. It is the point over which the gun center of the plotting board is adjusted. When the pintle center of a gun is taken as the directing point, such gun is called the directing gun.

Q. What point at the battery is usually taken as the directing point?

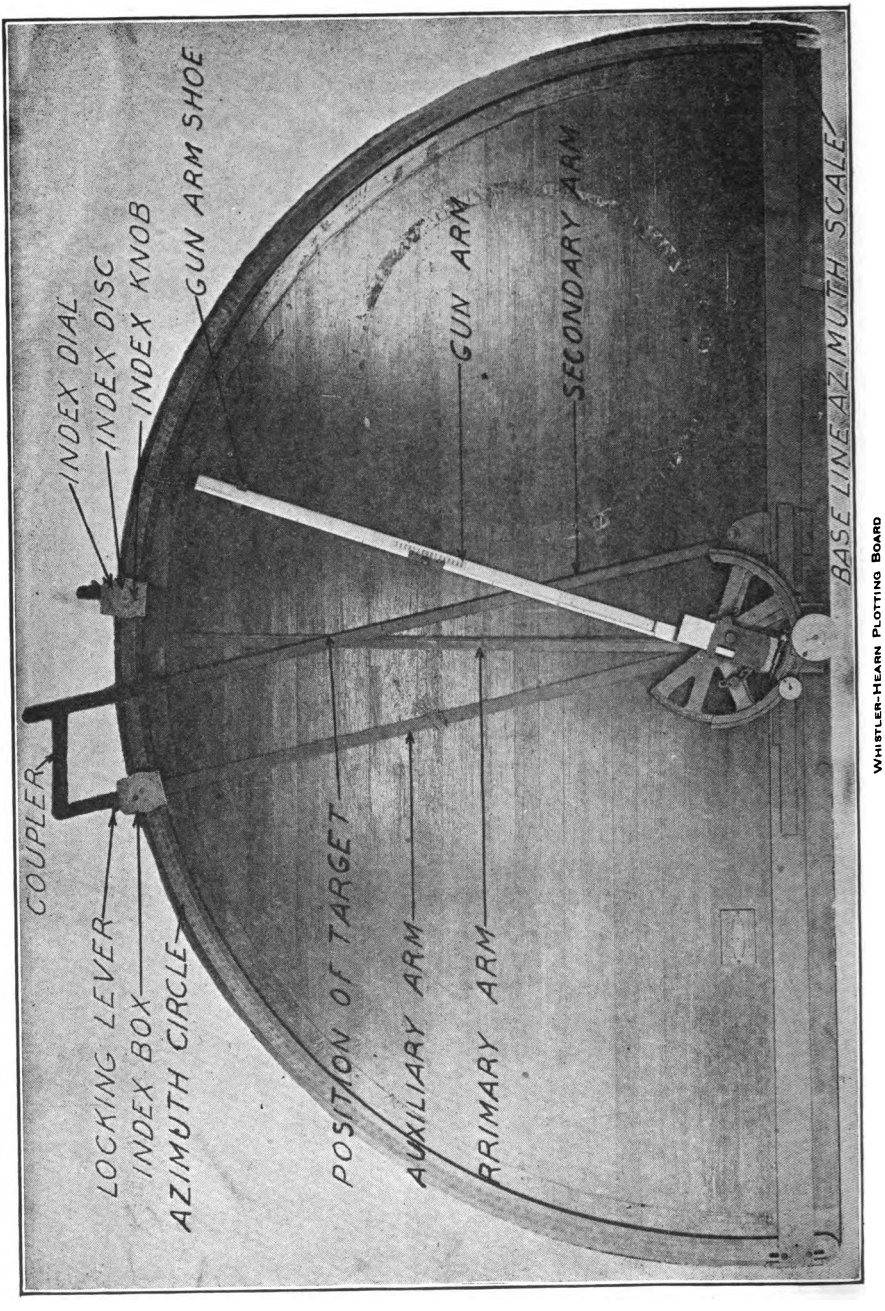
A. The Battery Commander's observing instrument is the directing point when the B.C. station is at the battery.

Q. Why is the B.C. instrument taken as the directing point?

A. So that the azimuth read by the B.C. instrument can be set off on the plotting board by using the gun arm.



WHISTLER-HEARN PLOTTING BOARD. (GUN ARM CENTER)



WHISTLER-HEARN PLOTTING BOARD

Q. What is meant by the displacement of any point?

A. The horizontal distance in yards of that point from the directing point.

Q. What is meant by gun displacement?

A. The horizontal distance in yards of the pintle center of a gun from the directing point.

Q. What is the scale of this plotting board?

A. 300 yards = 1 inch. (300 ft. = 1 inch, for subcaliber practice.)

Q. Lay off a distance on the board of_____yards.

Q. Find the distance between two given points.

Q. Range and azimuth of a point from primary station being given, locate point on board.

Q. Range and azimuth of a point from secondary being given, locate the point.

Q. Find the range and azimuth of a given point from the directing point.

Q. Azimuth of target from primary 306.11°; secondary 208.11°. Plot the target and find its range and azimuth from directing point.

Q. What is meant by the observing interval?

A. The time in seconds between two consecutive observations on a target.

Q. What is the prescribed observing interval?

A. 30 seconds. Time interval bells in B′, B″, B.C., and at guns ring together and sound on the 28th, 29th, and 30th seconds.

Q. What is meant by tracking?

A. The process by which the successive positions of a moving target are plotted on the plotting board. It includes the observations taken every 30 seconds by the observers at the position finding instruments, plotting the results of the observations by points on the plotting board, and drawing a line between these points.

Q. In what seven different ways may a target be tracked?

A. 1. *Horizontal Base.*—Every thirty seconds the reader in *B′* (*B prime*) sends the azimuth of the target to No. 2 (primary-arm setter). The latter sets the primary arm to this azimuth and calls "set." At the same time the reader in *B″* (*B second*) telephones the azimuth of the target to No. 3 (secondary-arm setter). The latter sets the secondary arm to this azimuth, and calls "set." The plotter places the targ

accurately at the intersection of the arms and marks on the plotting board the position of the target as thus plotted.

2. *B′* (*B prime*) *Auxiliary Base.*—This is like horizontal base. The secondary arm is laid aside. Every thirty seconds the reader in *B′* (*B prime*) telephones the azimuth of the target to No. 2 (primary-arm setter). The latter sets the primary arm to this azimuth and calls "set." At the same time the reader at the azimuth instrument at the directing point sends the azimuth of the target to No. 3 (secondary-arm setter). The latter sets the gun arm to this azimuth, using the diagonal scale and calls "set." The plotter places the targ accurately at the intersection of the arms and marks on the plotting board the position of the target as thus plotted.

3. *B″* (*B second*) *Auxiliary Base.*—The primary arm is laid aside. Every thirty seconds the reader in *B″* (*B second*) telephones the azimuth of the target to No. 3 (secondary-arm setter). The latter sets the secondary arm to this azimuth and calls "set." At the same time the reader at the azimuth instrument at the directing point sends the azimuth of the target to No. 2 (primary-arm setter). The latter sets the gun arm to this azimuth, using the diagonal scale, and calls "set." The plotter places the targ accurately at the intersection of the arms and marks on the plotting board the position of the target as thus plotted.

4. *B′* (*B prime*) *Vertical Base.*—The range officer throws the switches so as to bring both arm-setters' telephones in multiple with the reader's telephone in *B′*. The secondary arm is laid aside. The reader in B′ sends the range and azimuth of the target every thirty seconds. No. 2 (primary-arm setter) sets the primary arm to the azimuth. No. 3 remembers the range and calls it to the plotter as soon as No. 2 has called "set." The plotter places the targ against the primary arm at the range called by No. 3, and marks on the plotting board the position of the target as thus plotted.

5. *B″* (*B second*) *Vertical Base.*—The range officer throws the switches so as to bring both arm setters' telephones in multiple with the reader's telephone in *B″*. The reader in B″ sends the range and azimuth of the target every thirty seconds. The primary arm is laid aside. No. 3 (secondary-arm setter) sets the secondary arm to the azimuth. No. 2 (primary-arm setter) remembers the range and calls it to the plotter as soon as No. 3 has called "set." The plotter places the targ against the secondary arm at the range called by

No. 2 and marks on the plotting board the position of the target as thus plotted.

6. *Coincidence System.*—Only one arm is used. If the coincidence instrument is close to the battery, the gun arm is used. The description will be given for this condition. The primary and secondary arms are laid aside. Every thirty seconds the azimuth of the target is sent from the azimuth instrument at the directing point to No. 2 (primary-arm setter). The latter sets the gun arm to this azimuth, using the diagonal scale and calls "set." At the same time the range of the target is sent to No. 3. The latter remembers this range and calls it to the plotter as soon as No. 2 has called "set." The plotter places the targ against the gun arm at the range called by No. 3 and marks on the plotting board the position of the target as thus plotted.

The *coincidence system* is similar, in the method of operation, to the *vertical base systems.*

7. *Emergency System.*—As provided for the particular battery.

Q. What is the *predicted point?*

A. It is the place where we expect the target to be on the next bell.

Q. What is the *set-forward point?*

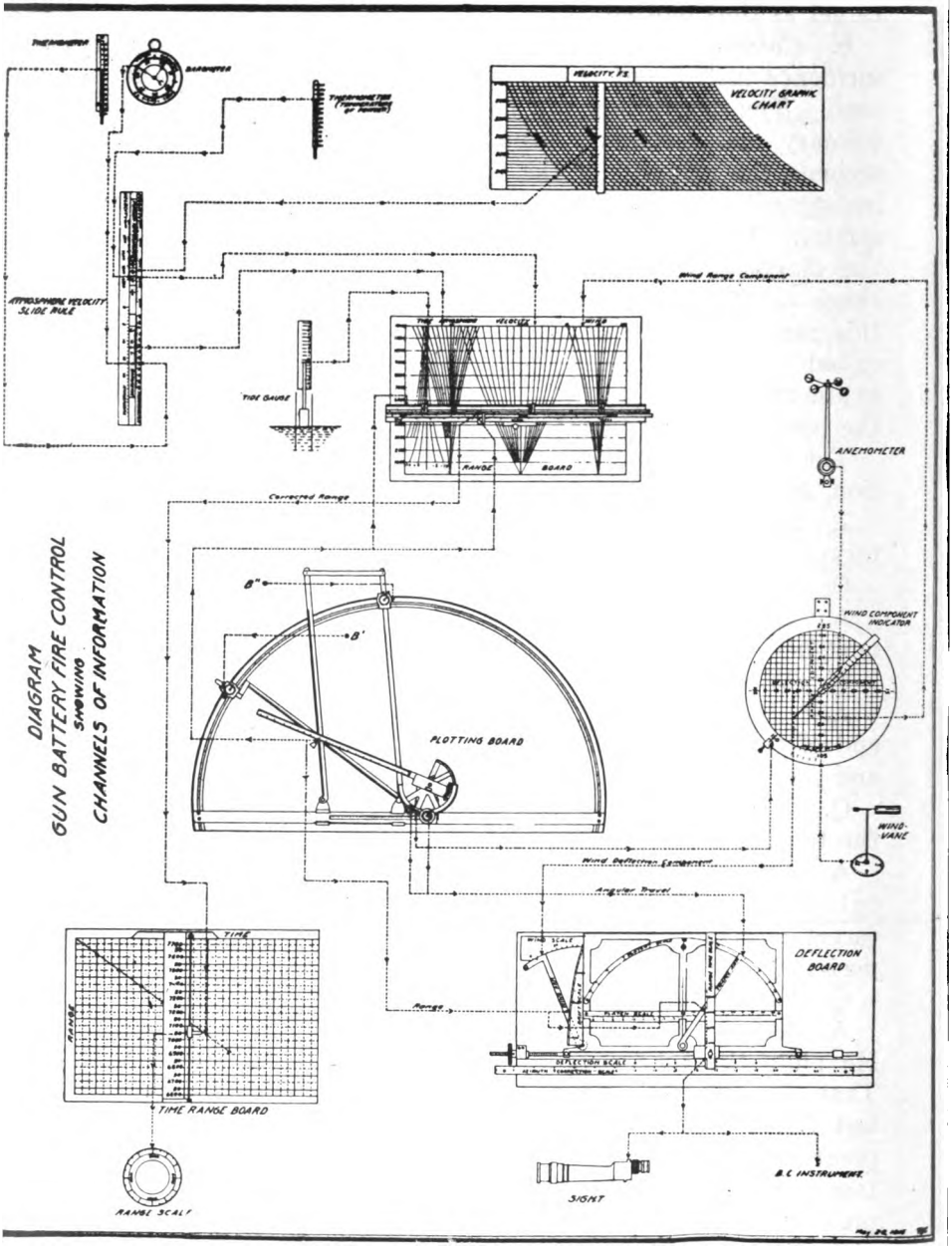
A. It is the place where we expect the target to be at the end of the time of flight: that is, the place where the target and projectile will arrive at the same time.

Q. What does the plotter do after two or more positions of the target have been plotted?

A. He commands or signals "Clear." The arms are moved out of the way. He estimates the direction in which the target is going and locates the set-forward point on the expected course of the target.

Q. How does he plot the set-forward point?

A. He uses a device prescribed by the battery commander. He plots the set-forward point for firing on the next bell. That is, he measures how far the target traveled during the last thirty seconds; he then measures from the last plotted point (and along the expected course of the target), a distance which is equal to the travel during the last thirty seconds plus the travel to be expected during the time of flight. He plots the set-forward point so determined. Therefore, if the gun is fired on the next bell, the set-forward point is where the target is expected to be when the projectile strikes. We



must endeavor to make the projectile strike at this range and in this direction.

Q. What does the plotter do as soon as the set-forward point is plotted?

A. He brings the gun arm up to the set-forward point and reads the actual range to No. 4 (range correction board operator), being sure that the range correction scale is always set and clamped at the reference number 2000 which is normal.

Q. What is meant by the *angular travel* of the target?

A. It means the change in azimuth (or direction) of the target during a given time—either during the observing interval or during the time of flight. If we determine what the angular travel was during the last thirty seconds, the deflection board will give the correction for the angular travel during the time of flight.

Q. How is the angular travel during the last thirty seconds measured?

A. The plotter brings the gun arm up to the last plotted point. No. 1 (assistant plotter) sets the tally dial to 15 (normal) and the subdial to 0 (normal), and then makes sure that the dials are not moved before the next reading. When the position of the target is plotted thirty seconds later, the gun arm is brought to this new point. The angular travel during thirty seconds (between the plotted points) will be indicated as a reference number on the tally dial and the subdial.

No. 1 (assistant plotter) reads the angular travel reference number to No. 5 (deflection board operator). No. 1 (assistant plotter) then sets the tally dial and subdial to normal again, to get the angular travel during the next thirty seconds. The plotter does not move the gun arm until the tally dial and the subdial are set at normal.

Note:—The following alternative methods are permissible:

1. The angular travel may be measured between set-forward points, instead of between plotted points.

2. The plotting board need not be used for measuring the angular travel. Instead, the change in azimuth of the target during thirty seconds (for use on the deflection board) may be measured by an observing instrument near the battery.

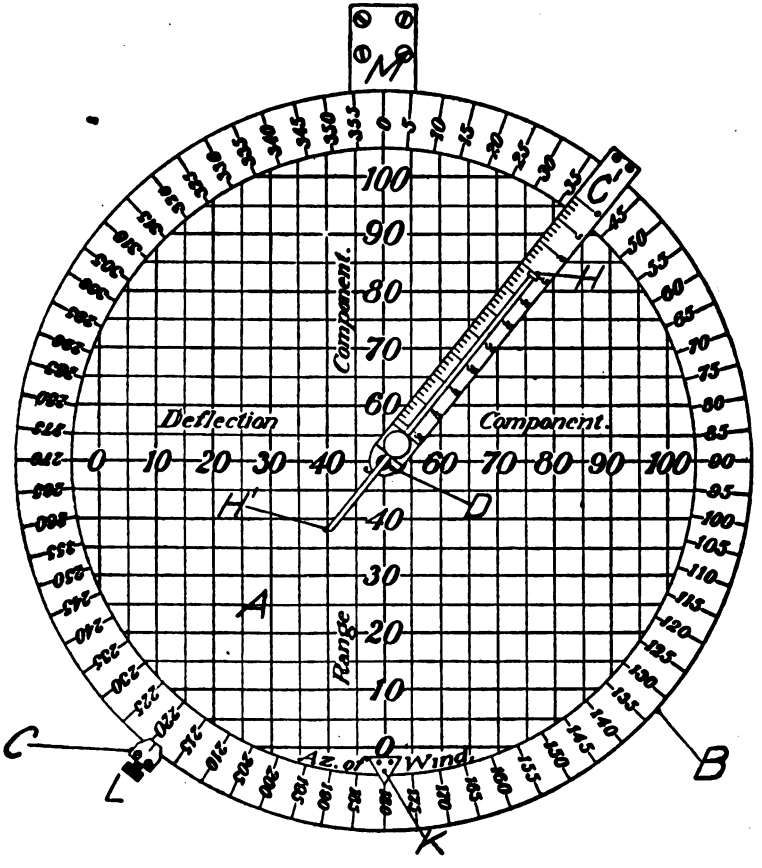
III. DAILY MESSAGE AND WIND COMPONENT INDICATOR

Q. What is the daily message, or as sometimes called, the "meteorological message"?

A. It is a message from the meteorological station, usually transmitted through the F.C. (fire commander) station. It contains information for correcting the range, deflection, or azimuth to be used at the guns before firing.

Q. How often is the daily message received?

A. At least every half hour.



WIND COMPONENT INDICATOR

Q. What information does it contain?

A. 1. Height of tide;

2. The azimuth in degrees from which the wind is blowing;

3. Wind velocity in miles per hour;

NOTE. The ballistic wind may be used. This is the wind velocity, in miles per hour (or meters per second), and the azimuth in degrees from which the wind is blowing. These

data are obtained by observing and plotting the course of a small free balloon from the time it leaves the ground until it reaches the highest point of the trajectory for the range at which the gun is to be fired. The wind velocity and azimuth are not for any one level but show the effect upon the projectile during its entire flight. As the wind curve issued with the Pratt Range Board is not intended for the Ballistic Wind, if the latter is used the Battery Commander must draw a new curve suitable for use with the Ballistic Wind.

4. Atmosphere reference number. (Usually the thermometer and barometer readings, from which the atmosphere reference number was determined, are also sent.)

Q. What use is made of the wind azimuth and velocity?

A. They are used on the wind component indicator.

Q. Tell how to use the wind component indicator.

A. (See illustration of Wind Component Indicator.) Set the pointer (H) to the wind velocity, and by turning the movable azimuth ring (B) bring the wind azimuth to the pointer (K). Set the target arm (C′) to the azimuth of the target, as indicated by the gun arm of the plotting board, using the index (C).

The reference numbers to be used on the range and deflection boards are indicated by the end (H′) of the pointer. Always read the figures which run up and down for range board wind reference number, and the figures which run right and left for deflection board wind reference number.

Q. If the temperature of the powder was 68 degrees when trial shots were fired, and the velocity determined from the trial shots was 2235 f.s., what velocity should be used when the same powder has a temperature of 75 degrees?

IV. THE RANGE CORRECTION BOARD

Q. What information is necessary to operate the range correction board, and where is it obtained?

A. 1. *Height of tide:* from daily message or direct from F.C. station.

2. *Atmosphere reference number:* from daily message.

3. *Muzzle velocity:* from battery commander.

4. *Wind reference number:* from wind component indicator.

5. *Range to set-forward point:* from gun arm of plotting board.

Q. How do you keep track of this information on the range correction board?

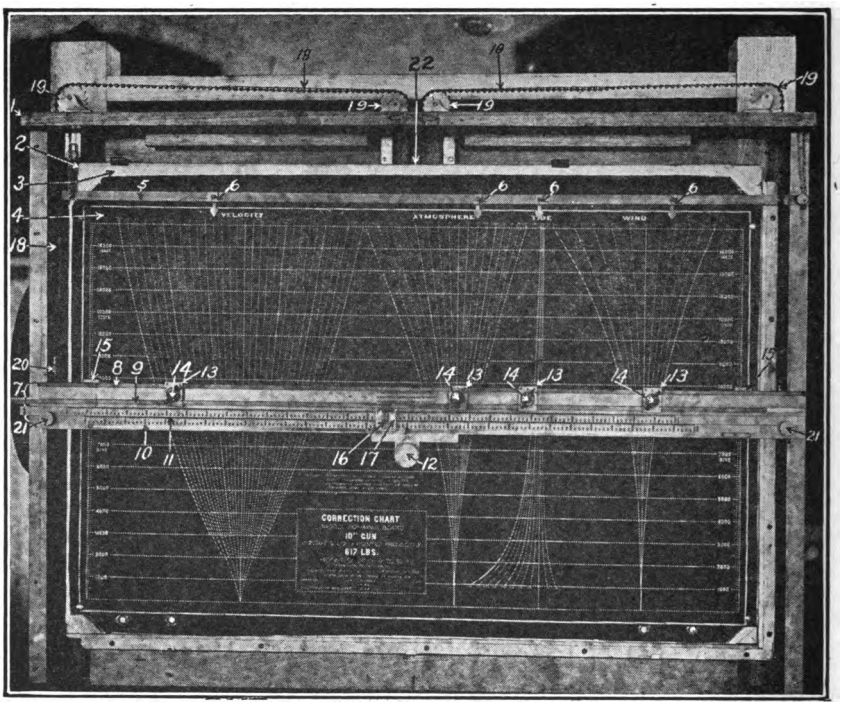
A. By sliding the markers at the top of the board so that they point to the numbers of the curves to be used.

Q. Explain the complete operation of the range board.

A. 1. Set each *marker* (*6*) at its proper correction curve.

2. Set each *pointer* (*13*) at normal (red line).

3. Make the *fixed* (*10*) and *movable* (*11*) *range scales* coincide..



RANGE BOARD, MODEL 1905

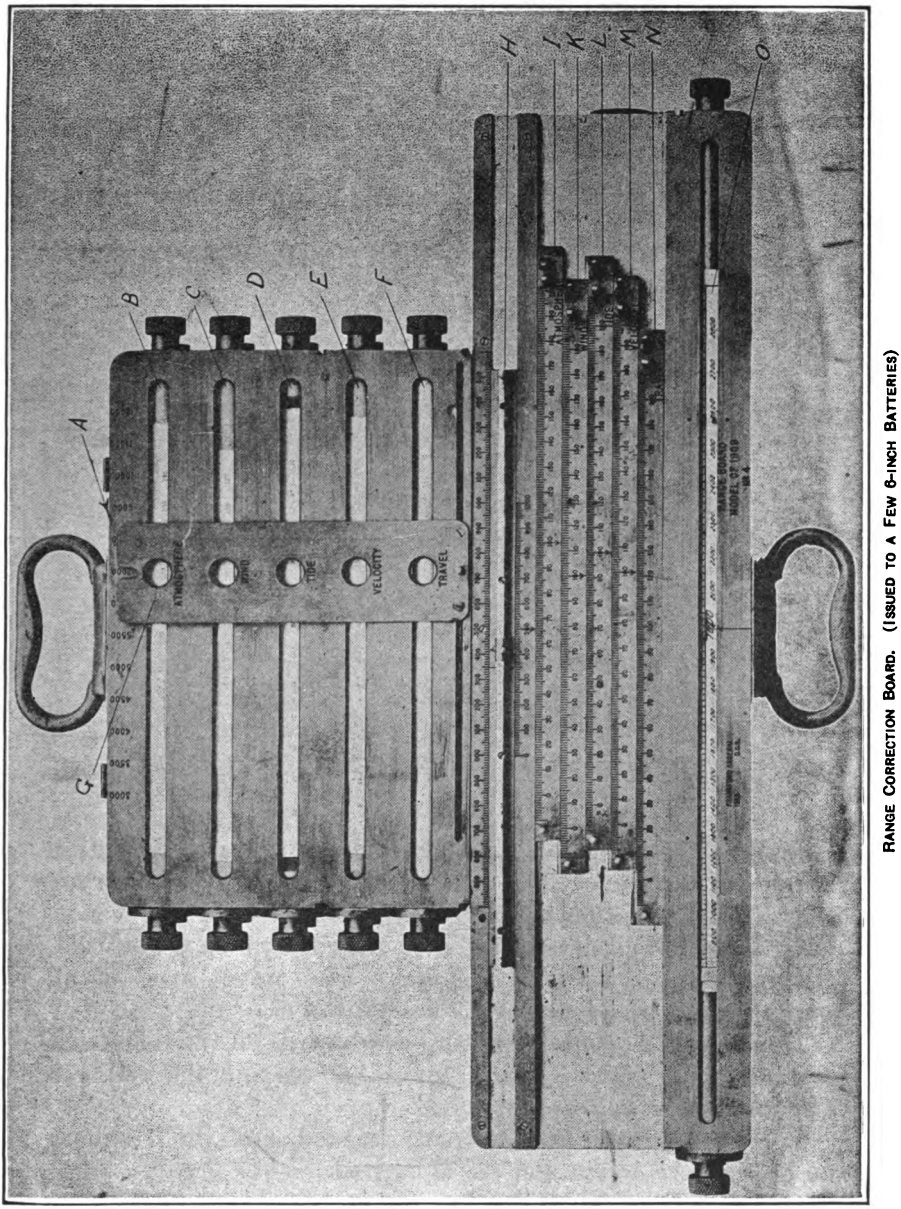
1. BOX (MAHOGANY).
2. CHART FRAME.
3. CANVAS CHART MOUNT.
4. CORRECTOR CHART.
5. BAR FOR MARKERS.
6. MARKERS (CURVE INDICATORS).
7. CORRECTION RULER.
8. FIXED BAR.
9. MOVABLE BAR.
10. FIXED RANGE SCALE.
11. MOVABLE RANGE SCALE.
12. KNOB.
13. POINTERS.
14. CLAMP.
15. FIXED INDEXES.
16. MOVABLE INDEX.
17. READING GLASS.
18. CHAIN.
19. CHAIN SPROCKET.
20. CHAIN ADJUSTING SCREW.
21. CLAMPING SCREW.
22. COUNTERWEIGHT (CONCEALED BY CHART FRAME).

4. Set the *movable index* (*16*) at the actual range of the set forward point, on the fixed range scale.

5. Set the *ruler* (*7*) at the actual range of the set-forward point.

6. Make the correction for atmosphere as follows:

a. Turn the *clamp* (*14*) to *M;*



RANGE CORRECTION BOARD. (ISSUED TO A FEW 6-INCH BATTERIES)

b. Turn the *knob* (*12*) until the pointer indicates the proper correction curve;

c. Turn the *clamp* (*14*) to *S*.

7. Make the correction for velocity in a manner similar to that indicated in 6 above for atmosphere.

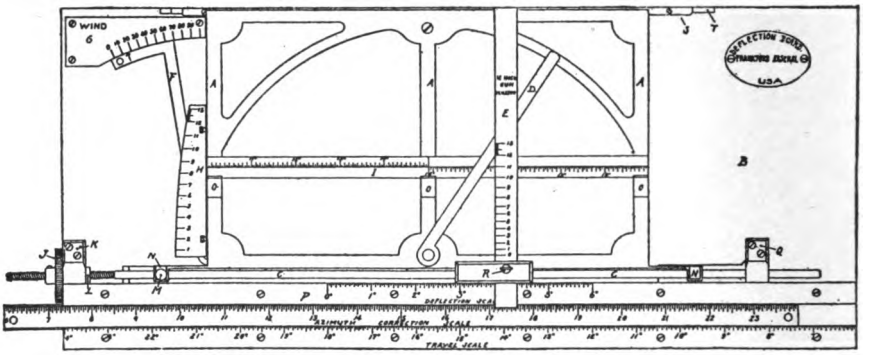
8. Make the correction for tide in a manner similar to that indicated in 6 above for atmosphere.

9. Make the correction for wind in a manner similar to that indicated in 6 above for atmosphere.

10. Read the corrected range on the *movable scale* (*11*) at the index under the reading glass.

Q. What is done with the corrected range?

A. It is sent to the time-range board.



DEFLECTION BOARD (OLD MODEL)

V. THE DEFLECTION BOARD

NOTE:—There are two slightly different types of deflection boards in service. Both are illustrated. The later type differs from the earlier in the following respects:

(1) The travel arm is serrated on the edge which is not used, to avoid its use through mistake. The travel arm on all boards should be so prepared.

(2) There is a pointer pointing downward, on the deflection scale just below the 3 mark, for use in setting the azimuth correction scale.

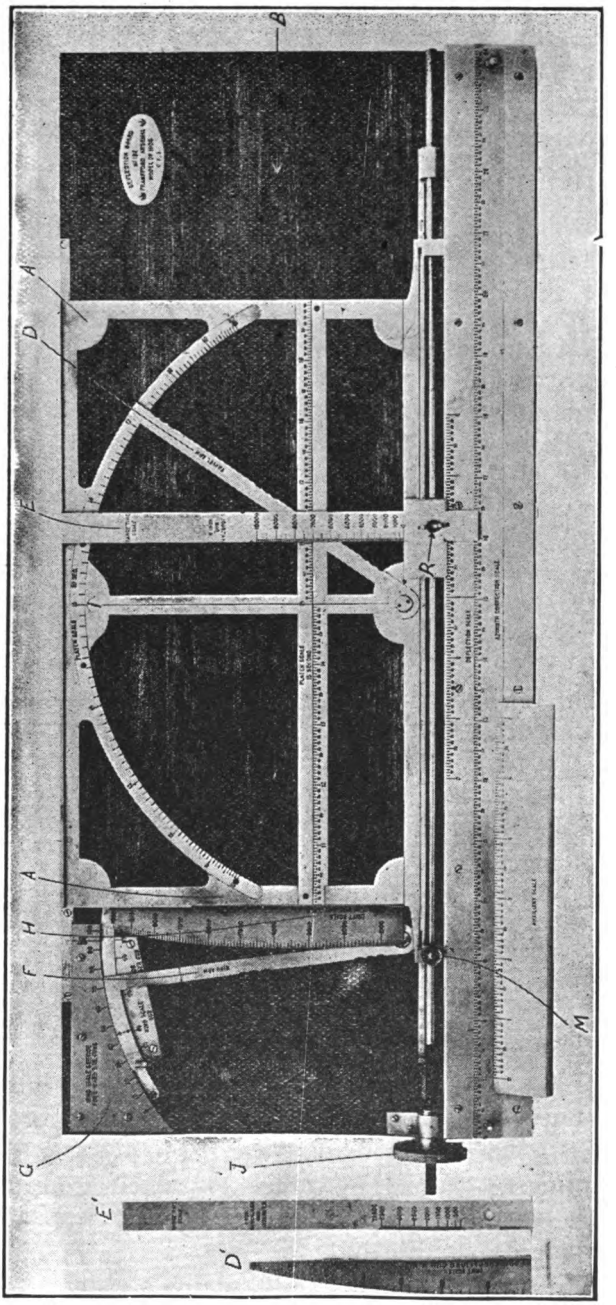
(3) The T-square knob (*R*) is threaded, and the T-square can be clamped to the rod (C) if desired.

(4) There is no travel scale at the bottom of the board.

Q. Point out the following:

Platen.

Platen scale (30-second).



DEFLECTION BOARD (NEW MODEL)

(Note:—Platen scale, 15-second, is not used.)
Travel arm.
T-square scale (service and subcaliber).
Leaf range scale (service and subcaliber).
Wind arm.
Wind arc (service and subcaliber).

Q. Which edge of the wind arm or of the travel arm is always used in setting off readings.

A. The one which if prolonged would pass through the center of the pivot of the arm.

Q. What is meant by the *deflection*?

A. It is the difference between the azimuth of the target and the azimuth at which the bore is pointed. Deflection must be used so that when the piece is fired with the line of sight on the azimuth of the target, the shot will strike on the azimuth at which the target will be the end of at the time of flight.

Q. What causes affect the value of the deflection correction?

A. Lateral effect of the wind, drift, and angular travel of the target during the time of flight, affect the total deflection correction.

Q. What information is necessary in order to operate the deflection board?

A. 1. The *wind reference number* obtained from the wind component indicator.

2. The *actual range to the target*, obtained from the gun arm of the plotting board.

3. The *angular travel* of the target, during 30 seconds, obtained at the plotting board and called off by No. 1 (assistant plotter) using the tally and hundredths dials.

Q. Explain how to operate the board to obtain the deflection for the sight.

A. (See illustration of the deflection board.)

1. Set the wind arm (F) to the proper reference number, as indicated by the wind component indicator.

2. Set the platen (A) so that the point of the drift curve corresponding to the actual range, obtained from the gun arm of the plotting board, will be accurately over the sight hand edge of the wind arm.

3. Using the circular, 30 second, platen scale, set the outer end of the travel arm (D) for the travel reference number read from the tally dials of the plotting board.

4. Set the T-square (E) so that the point of its scale corresponding to the actual range, obtained from the gun arm of the plotting board, will be accurately over the edge of the travel arm;—right hand for old model board, and left hand for new model.

The beveled edge of the T-square (E) then indicates on the deflection scale the deflection to be used on the sight with Case I or II.

Q. How is the deflection board used in Case III?

A. Different methods are used at different batteries.

The set-forward point having been located on the plotting board, before its azimuth is sent to the guns it must be corrected for wind and drift. One method of using the deflection board for the purpose is as follows:

1. Set the 15 graduation of the azimuth correction scale at normal of the deflection scale (unless an arbitrary correction is ordered).

2. Set the wind arm (F) to the proper reverence number.

3. Set the platen (A) so that the point of the drift curve corresponding to the range will be accurately over the right hand edge of the wind arm.

4. Set the travel arm out of the way, and set the T-square on the "median line" of the platen.

The beveled edge of the T-square (E) then indicates on the azimuth correction scale the reference number to be set on the azimuth correction scale *on the rear part of the gun arm of the plotting board.*

5. On the plotting board bring the gun arm up to the set-forward point and read the azimuth on the gun arm azimuth circle and subdial.

6. The gun is fired on the third stroke of the next bell.

NOTE.—If it is desired to fire on observation, the predicted point also is plotted and its azimuth read from the diagonal scale on the plotting board. This azimuth is set on the B.C. instrument and the guns fired when the target crosses the vertical wire.

Q. How are the battery commander's arbitrary corrections applied to the deflection board?

A. Different methods are used at different batteries.

First Method: Using Auxiliary Scale

1. The battery commander follows the target with the cross wire of a telescopic sight or the pointer of a 1910 azimuth in-

strument. As soon as the splash appears, he stops his instrument and if the splash is not at the target he moves the vertical wire or pointer to bisect the splash. The reading of the cross wire or pointer is then sent to the deflection board.

2. The deflection board is operated in the usual manner. The 3° reading of the auxiliary scale is then placed opposite the beveled edge of the T-square. As soon as the battery commander's reading of the splash is received, the T-square is moved to this reading on the auxiliary scale.

3. The beveled edge of the T-square then indicates on the deflection scale the corrected deflection to be used on the sight and is sent to the guns.

Second Method: Using Azimuth Correction Scale

The method to be described requires that the numbers 1, 2, 3, 4, and 5 be placed above (or below) the numbers 13, 14, 15, 16, and 17 respectively of the (sliding) azimuth correction scale. This scale is then set with the 3 graduation opposite the 3 on the deflection scale and used in place of the deflection scale (a strip of paper is usually pasted over the deflection scale so it cannot be used through error).

1. The board is operated in the usual manner and the deflection is read from the sliding scale and sent to the B.C. and the guns.

The battery commander follows the target with the vertical wire of a telescopic sight or pointer of 1910 azimuth instrument set at the same deflection as is being used at the guns. As soon as the splash appears he stops his instrument, and if the splash is not at the target he moves the vertical wire or pointer to bisect the splash. This gives the deflection which should be used for the next shot and the B.C. can check his work by requiring the gun pointer who fired the shot to call out to him what correction he would use for the next shot. It is now necessary to apply this correction to the deflection board as follows:

2. With the platen and T-square held in the same position as when the last deflection was sent to the guns, move the sliding scale until the beveled edge of the T-square reads the corrected deflection sent by the battery commander. This corrected deflection is at once sent to the guns for Case II. At the same time the new azimuth correction can be applied on the azimuth correction scale on the gun arm for Case III.

3. Continue the operation of the board as wind, range, and

travel change, reading deflections from the sliding scale, and taking care to see that the sliding scale does not move unless further arbitrary correction is ordered by the battery commander. The position of the sliding scale after an arbitrary correction should be marked by a pencil line at one end of the scale.

ALTERNATE PLOTTING STATION ORGANIZATION AND EQUIPMENT

(This section covers organization and equipment along the general lines described in the JOURNAL OF THE UNITED STATES ARTILLERY for June, 1920, pages 584-604 inclusive. The questions below cover the system as designed *for fire by Case III only.* To use this system for Case II, the Direction Correction Board and the Direction Prediction Board may be discarded and the standard Deflection Board for guns used to determine the gun deflection; or the Battery Commander may continue to use these boards if he devises an instrument for converting the readings of the Direction Prediction Board in sight deflection.)

Manning Party

Q. Name the members of the plotting room manning party.

A. Plotter, who plots the course of the target on plotting board and has general charge of the work in plotting room.

No. 1. Assistant plotter, who assists the plotter and operates wind component indicator.

No. 2. Primary arm setter, and

No. 3. Secondary arm setter, who set off azimuth sent from observing stations using primary and secondary arms.

No. 4. Range Prediction Board Operator, who determines on the range prediction board, the range to the set forward point, applies arbitrary range corrections given by the range officer and also applies ballistic range corrections as determined by the Pratt Range Correction Board Operator.

No. 5. Assistant Range Prediction Board Operator, who assists No. 4.

No. 6. Direction Prediction Board Operator, who determines on the prediction board, the azimuth to the set forward point, who applies arbitrary deflection corrections given by the range officer and also applies ballistic deflection corrections as determined by the Direction Correction Board Operator.

No. 7. Assistant Direction Prediction Board Operator, who assists No. 6.

No. 8. Range Correction Board Operator, who determines on the Pratt Range Board range corrections due to velocity, atmosphere, tide and wind.

No. 9. Direction Correction Board Operator, who determines the corrections in direction due to wind and drift.

No. 10. Deflection Computing Device Operator, who converts azimuth into deflection to be set on the sight. (No. 10 has no duties when firing is by Case III. He is used only when firing is by Case II.)

Operation of plotting board

(The standard Board is used)

The primary and secondary arm setters set the primary and secondary arms to the azimuths received from the observing stations.

Using the targ, the plotter marks the intersection of these arms and as soon as the arms are cleared, places the mortar arm so as to read the range from the directing point to this plotted point. The assistant plotter reads the azimuth of this point.

Meteorological message and wind component indicator

These are standard. The reference numbers obtained are used on the standard range correction board, and on the direction correction board.

Range correction board

This is the standard Pratt Range Board. It is operated in the usual way, except that instead of reading the corrected range opposite the uncorrected range, the range on the movable range scale opposite 11,000 on the fixed range scale is read and applied on the *ballistic correction scale* of the Range Prediction Board as a reference number, the scale on this prediction board being graduated in such a way as to make this possible.

Direction Correction Board

Q. What information is necessary to operate the direction correction board, and where is it obtained?

A. 1. Wind reference number: From wind component indicator.

2. The factor determining drift, which is the range:

From the range obtained by the reading of mortar arm by plotter.

Q. How do you keep track of this information on the direction correction board?

A. This board is similar in design and construction to the Pratt Range Board and is operated in the same manner. The only difference being that the corrections are for lateral deviations. The curves are for wind and drift.

Q. What readings are obtained from this board and how are they used?

A. The value on the fixed scale opposite 11,000 on the movable scale is read and is set off on the direction prediction board as a reference number.

Range Prediction Board

Q. What information is necessary to operate the range prediction board?

A. 1. The true range to the plotted points, given by the plotter.

2. The range corrections, given by operator Pratt Range Board.

Point out the following:

Scale for prediction interval.
Time of flight scale.
Pointer.
Range reading scale.
Ballistic correction scale.
Fire adjustment scale.
Prediction Ruler.
"T" square blade.
Fixed Index.

Q. What is the value in time of one of the squares on the cross section paper, measured horizontally?

A. Thirty seconds.

Q. What is the value in range of one of the squares on the cross section paper, measured vertically?

A. One hundred yards.

Q. Where are arbitrary corrections received from the range officer made?

A. On the fire adjustment scale.

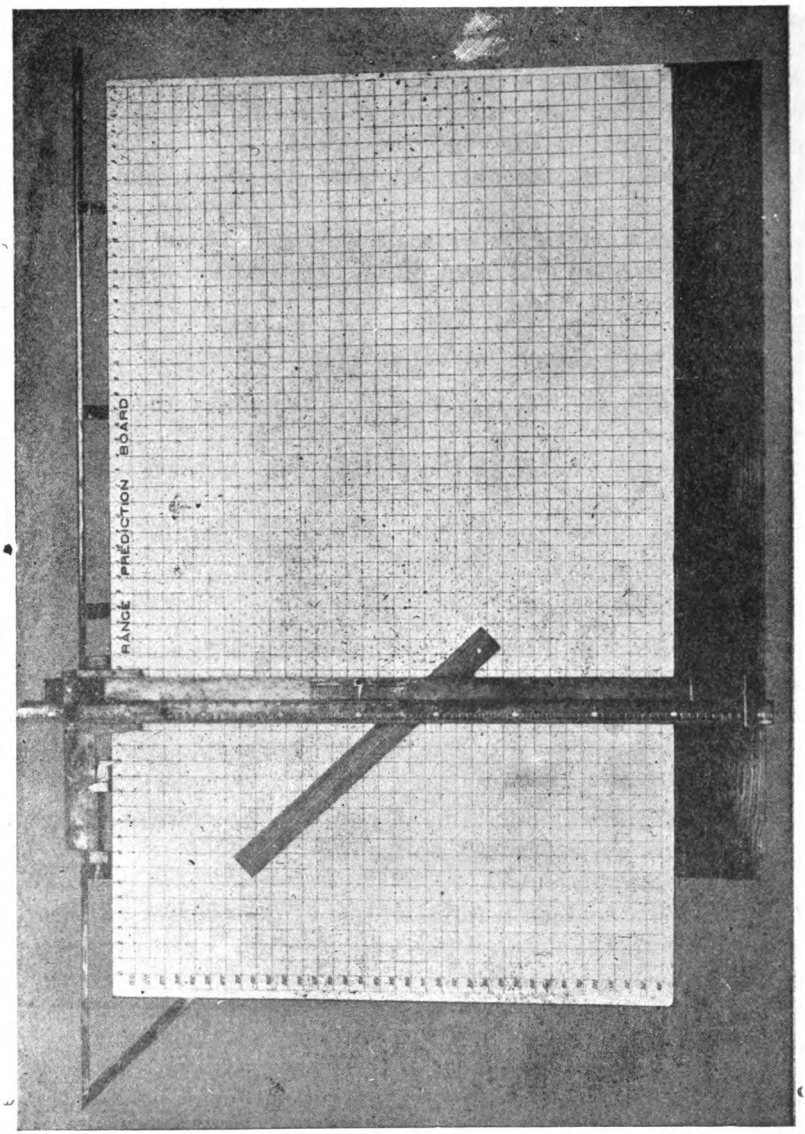
Q. Where are corrections received from the range correction board made?

A. On the Ballistic Correction Scale.

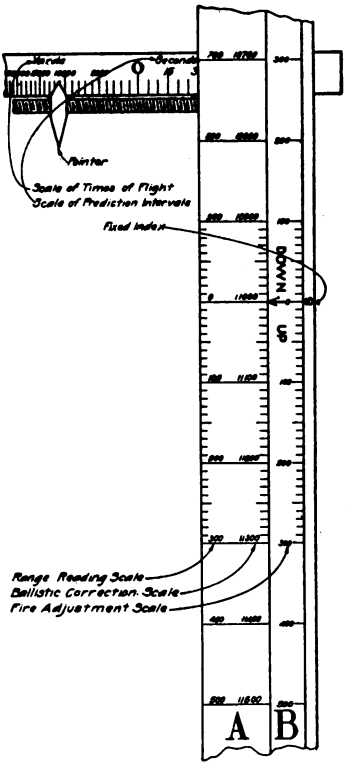
Q. What is the normal on the ballistic correction scale?

A. 11,000.

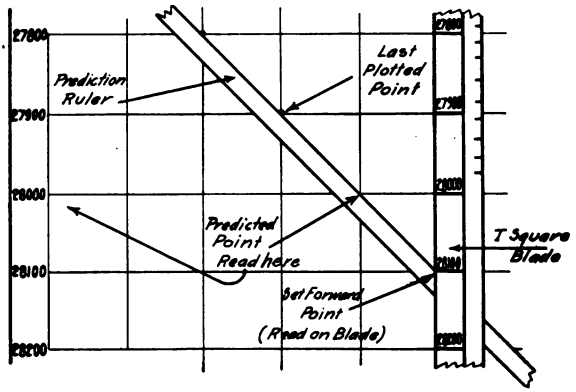
Q. What is the normal of the fire adjustment scale?



RANGE PREDICTION BOARD



DETAIL OF T-SQUARE, RANGE PREDICTION BOARD

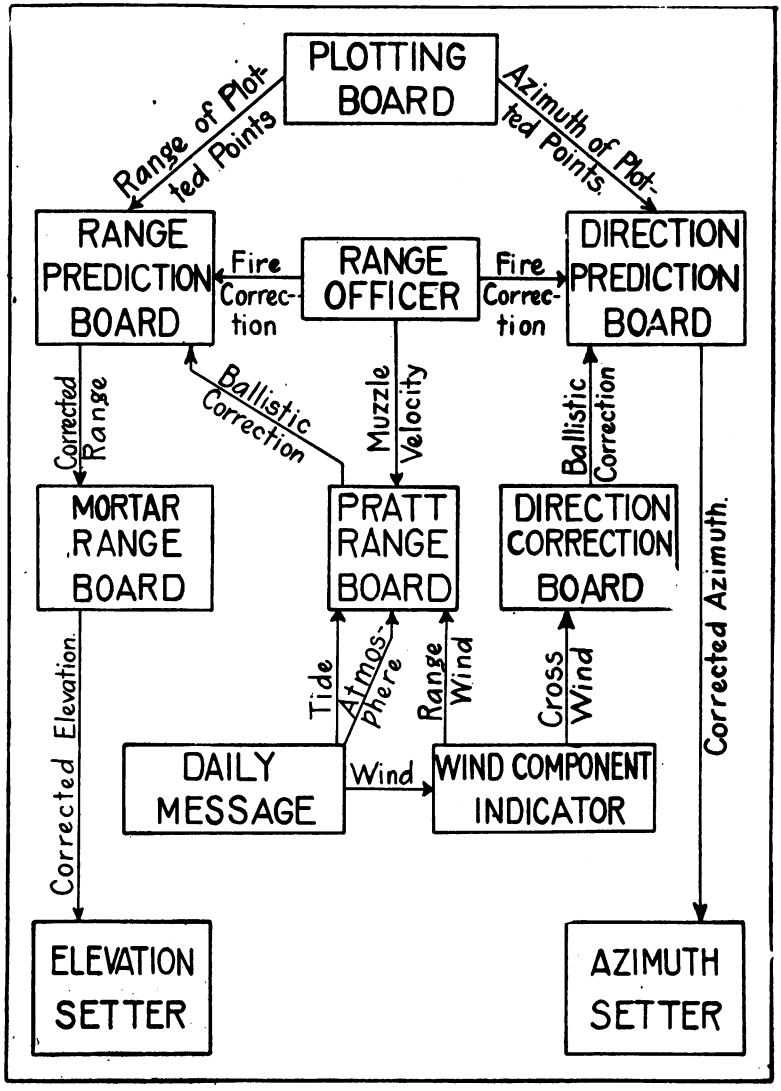


METHOD OF PLOTTING, RANGE PREDICTION BOARD

A. Zero.

Q. Explain the operation of the range prediction board.

A. (a) The plotted point is indicated by a dot on the cross section paper, on the proper time line, and on the proper



range line. The range in hundreds of yards only, is shown in the column on the left hand margin, so the thousands are filled in with pencil.

(b) The position of the second plotted point is shown in the same manner and is to the right on the next time line and either up or down depending on whether the range for the second plotted point is less or greater than the first.

(c) The time of flight scale is adjusted so as to read the range of the last plotted point.

(d) The pointer is placed directly above the last plotted point.

(e) The prediction ruler is so placed that the edge touches both plotted points and the ruler passes under the T square. The corrected range to the set-forward point is read on the T square at the point where the range prediction ruler intersects the T square.

(f) The ballistic corrections (from the Pratt Range Board) and the fire adjustment corrections (from the range officer) are made on the proper scales.

Direction Prediction Board

Q. What information is necessary to operate the direction prediction board?

A. (1) The azimuth of the plotted points, given by the plotter.

(2) The correction obtained from the operator, direction correction board.

This board is similar in design and construction to the range prediction board and is operated in exactly the same manner.

The result obtained being the azimuth of the set-forward point, after arbitrary and ballistic corrections have been made.

(c) AIMING AND LAYING OF GUNS

Q. What kind of angles are used in aiming and laying guns?

A. Horizontal and vertical angles.

Q. When are horizontal angles used?

A. In giving direction to the gun, either by the sight or the azimuth scale.

Q. When are vertical angles used?

A. In giving the piece the proper elevation so that the projectiles will range to the target.

Q. What is Case I?

A. When direction and elevation are both given by the sight.

Q. Set gun in Case I. Deflection 2.35, elevation 5° 36′.

Q. Point out on the gun carriage: the service range scale; the subcaliber range scale; the elevation scale.

Q. Set the service range scale for 5445 yards; set the subcaliber scale for 3025 yards; set the elevation scale to read plus 5 degrees.

Q. What is Case II?

A. When direction is given by sight and the elevation is given by the range scale.

Q. Set gun in Case II. Range 7562 yards, deflection 3.10.

Q. If shot falls to right, do you increase or decrease setting of sight?

A. You decrease it.

Q. If shot falls to left, do you increase or decrease setting of sight?

A. You increase it.

NOTE.—In other words: to fire right, add; and to fire left, subtract.

Q. What is Case III?

A. When direction is given by the azimuth circle and elevation is given by the range scale.

Q. Given a range and azimuth, set them.

Q. If Case III is ordered and you get a range and azimuth, what time should the piece be fired on that data?

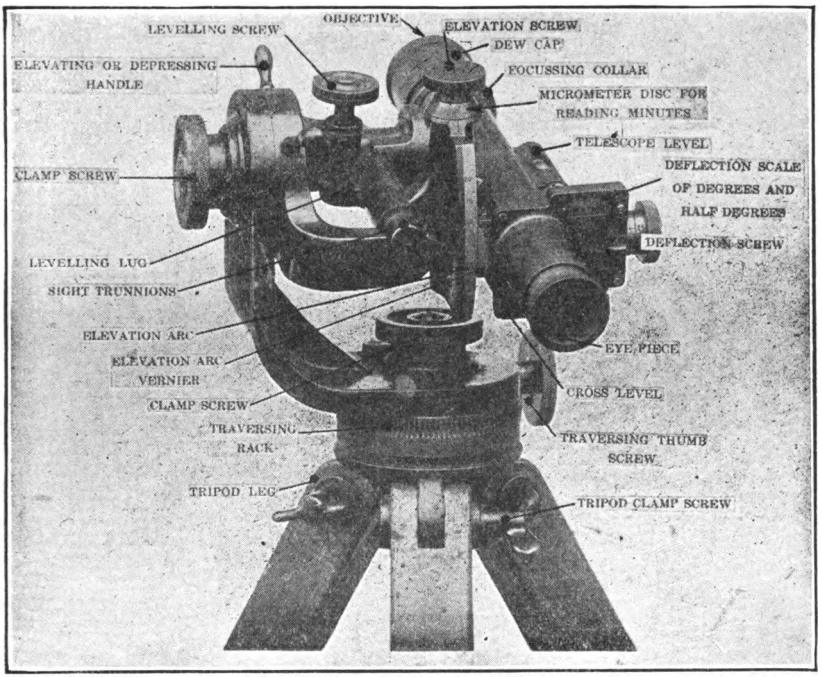
A. On the next bell, unless otherwise ordered.

Q. What care must be taken in seating a sight?

A. Do not remove a sight from its case until on the sighting platform. Remove the model 1898 MII sight by the strap. See that there is no dirt, grit, nor paint on the bearing surfaces between the sight and cradle or bracket. Always handle a telescopic sight with the utmost care, as it is a delicate instrument.

TELESCOPIC SIGHT, MODEL 1898 MII

Q. Name the principal parts of the telescopic sight, model of 1898 MII.



TELESCOPIC SIGHT, MODEL 1898 MII MOUNTED ON HAGOOD TRIPOD MOUNT

A. Sight trunnions, leveling lug, telescopic level, eye piece, focussing collar, dew cap, micrometer deflection screw, micrometer elevating worm spindle, cross level, outside deflection scale, vernier scale, line of collimation.

Q. How is sight seated on gun for Case I?

A. Remove sight, place it carefully in its seat on sight bracket on gun trunnion. Level cross-level with leveling lug. When telescope level reads zero the gun should show zero elevation.

Q. Where is sight placed in Case I, in Case II, in Case III?

A. In Case I it is placed on sight bracket on right trunnion. In Case II it is placed on sight standard. In Case III it is not used.

Q. What is the least reading of the outside deflection scale?

A. Fifty one-hundredths of a degree.

Q. What is the least reading of micrometer deflection scale and the inside deflection scale?

A. Five one-hundredths of a degree.

Q. Set the scale to read the following: 3.45, 2.70.

Q. What is the least reading of the elevation scale?

A. Thirty minutes.

Q. What is the least count of the elevation scale vernier?

A. Two minutes.

Q. What is the least reading of the micrometer elevating worm spindle?

A. One minute.

Q. Place the sight on Hagood tripod mount and level and focus it.

Q. Set off elevation of 5°23′; of 7°53′.

Q. Instructor to set off two readings and have candidate read elevation; first by using vernier, second by using micrometer elevating screw worm spindle.

Q. What is the telescopic sight used for?

A. It is used for the following purposes:

a. By gun pointers to give the gun direction when firing by Cases I and II.

b. By observers to tell how far to the right or left (lateral deviation) a shot falls.

Q. What is the smallest division on the micrometer deflection scale?

A. It is called "a point" and is equal to:

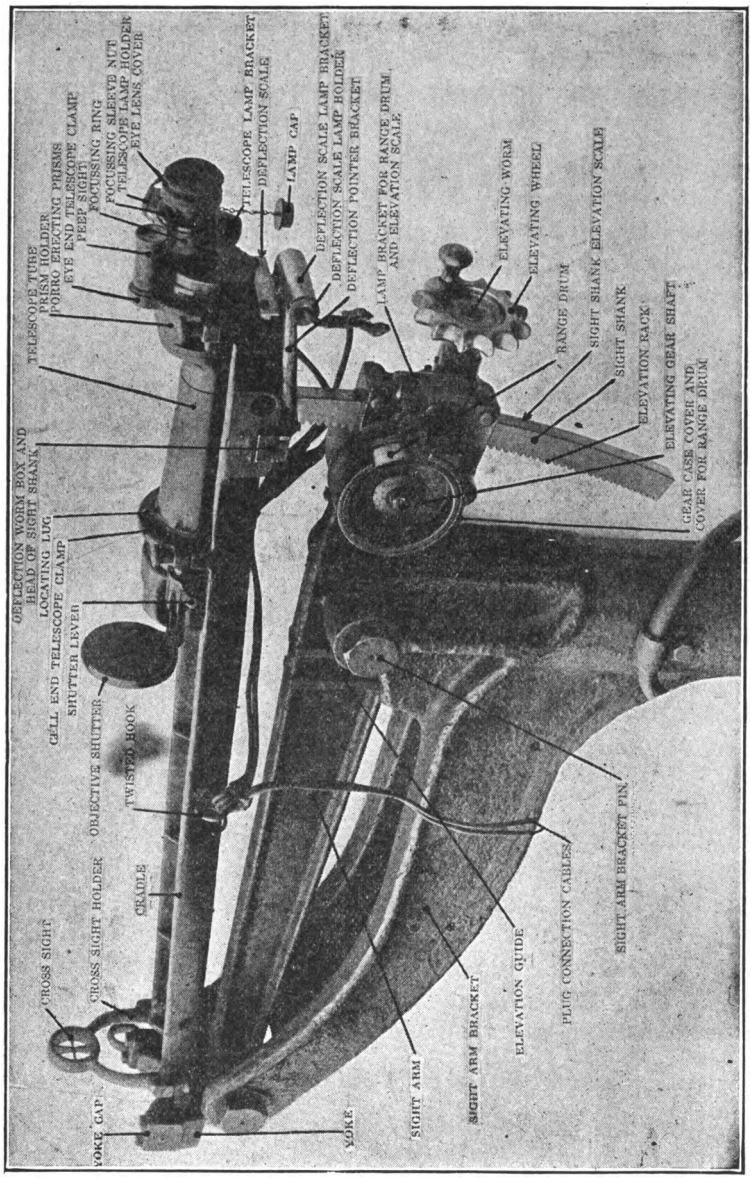
a. 3 Minutes.
b. .05 Degree.
c. 1 Mil or one one-thousandth of the range.

TELESCOPIC SIGHT, MODEL 1904*

Q. Name the principal parts of the telescopic sight, model of 1904. (See illustration on page 71.)

A. Telescope proper. Deflection worm and worm
Cradle and its fulcrum. box.

* The 2-in telescopic sight, model 1906, is similar to the model of 1904, except in its size and a few minor particulars.



TELESCOPIC SIGHT, M. 1904

Telescope clamps.
Open sights.
Sight shank, with elevation rack and elevation scale.
Deflection scale and pointer.
Elevating worm and wheel.
Range drum and cover.
Electric lamps and cables.

Q. Name the principal parts of the *telescope* of the 1904 sight.

A. Telescope tube.
Objective lens.
Porro erecting prisms with holder and cover.
Eye piece with field lens, eye lens and amber glass.
Cross wires and cross wire holder.
Focussing ring.
Lamp holders.
Objective shutter and handle.

Q. How is the sight placed in position for use?

A. Wipe bearing surfaces between sight and cradle clear of all grit or other foreign matter; place the sight (having the same serial number as the bracket) carefully in the cradle and secure it with the two clamps, making sure that the lug on the forward clamp fits accurately into its recess on the telescope body. Set the clamping screws well home. Run the sight cradle up or down until it is properly adjusted for the range at which the sight is to be used.

Q. What is the least reading of the deflection scale?*

A. Five one-hundredths of a degree.

Q. What is the smallest division on the deflection scale?

A. .05 (five hundredths) of a degree. This is 3 minutes, or 1 mil.

Q. What is a mil?

A. That angle which will include one yard at 1000 yards, 2 yards at 2000 yards, 3 yards at 3000 yards, etc., laterally on the target or field of fire.

Q. Set the scale to read the following: 3.45; 2.70.

Q. Focus the sight on some object as described for the azimuth instrument.

(d) TIME-RANGE BOARD

Q. Explain the use of the time-range board.

A. See Appendix "H."

* The graduations on the range drum and on the sight shank will not be used (see Ordnance pamphlet No. 1955, revised April 2, 1912).

(e) DEFINITIONS, D. R. C. A., 1914*

Q. What is the trajectory?

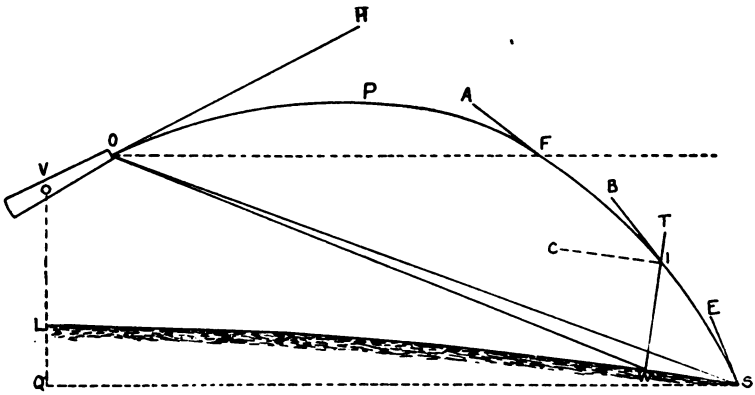
A. The curve described by the center of gravity of the projectile. (Draw and label it.)

Q. What is the axis of the bore?

A. The center line of the bore. (Draw and label it.)

Q. What is the line of departure?

A. The prolongation of the axis of the bore at the instant the projectile leaves the bore. (Draw and label it.)



OPS	Trajectory.	QS	Range of shot.
F	Point of fall.	TW	Target.
I	Point of impact.	ESQ	Angle of splash,—danger angle.
S	Point of splash.	HOF	Quadrant angle of departure.
W	Center of target.	AFO	Angle of fall (Range Table) for horizontal range OF.
LV	Height of site.		
OH	Line of departure.		

Q. What is the line of sight?

A. A straight line passing through the sights of the piece and the target. (Draw and label it.)

Q. What is drift?

A. It is the divergence from the plane of departure of the projectile under the influence of the rotation of the projectile and the resistance of the air. In our service it is always to the right. (Draw and label it.)

Q. What is muzzle velocity?

* See Appendix "B".

A. It is the velocity of the projectile as it leaves the muzzle, measured in feet per second.

Q. What is jump?

A. It is the increase or decrease of the elevation at the instant the projectile leaves the gun. (Draw and label it.)

Q. What is quadrant elevation?

A. The angle between the horizontal and the axis of the bore when the piece is pointed. (Draw and label it.)

Q. What is the quadrant angle of departure?

A. The angle between the horizontal and the axis of the bore at the instant of firing. (Draw and label it.)

Q. What is sight elevation?

A. The angle between the line of sight and the axis of the bore. (Draw and label it.)

Q. What is the danger angle, or angle of splash?

A. It is the angle that the tangent to the trajectory at the point of splash makes with the plane containing the point of splash and parallel to the horizontal plane through the muzzle of the piece in the firing position. (Draw and label it.)

Q. How is the angle of fall expressed?

A. Either in degrees and minutes, as 5° 16′, or as 1 on 17.

Q. What does 1 on 17 mean?

A. That the projectile falls vertically 1 yard in going 17 yards on the horizontal.

Q. What is time of flight?

A. The time required for the projectile to travel from the gun to the point of impact.

In addition to the questions and answers listed above, every first class gunner should be acquainted with the meaning of the terms listed below. They are defined in Appendix D. Instructors and examining officers should remember that nothing is gained, and much time is wasted, by compelling the soldier to learn these definitions in a parrot-like manner: all that should be required is that he be able to explain, *in his own words*, the general meaning of the term in a satisfactory manner.

Axis of the gun
Base point
Base line
Y-azimuth
Bore
Bore-sighting
Caliber
Crusher guage
Degree
Erosion
Field of fire
Fire, kinds of
In battery—From battery
Gun or piece

Cartridge case	A load
Clinometer	Lot, powder
Clinometer rest	Map range
Communications	Pressure cylinder
Mark one, (two, three, etc.)	Rated men
Mil	Recoil and counter-recoil
Meteorological station	Referring point
Point of burst	Registration point
Point of impact	Rifle and smooth bore
Pointing	Ricochet
Position finder	Round
Position finding instrument	Salvo
Primary armament	Salvo interval
Secondary armament	Sight
Parapet, parados, and traverse	Sub-caliber tube
Pyramidal target	Tide station
Range	Twist of rifling
Range finder	Zone
Range table	Relocation

In order that the soldier may understand the object of fire adjustment, and realize that even with perfect adjustment the shot may not strike the target, it is desirable that he should understand, *in a very general way*, the following terms:

Dispersion	50% zone
Dispersion ladder	
Calibration	Pattern
Center of impact	Danger space

(f) GENERAL FEATURES OF WARSHIPS

Q. How may warships be classified?

A. The general broad classification which is at present accepted throughout the world is:

(1) Armored ships, including:
  (a) Dreadnoughts (16,000 tons and over).
  (b) Battle-cruisers (dreadnoughts) (17,000 tons and over).
  (c) Battleships (pre-dreadnoughts) (11,000 to 16,000 tons).
  (d) Armored cruisers (9000 to 15,000 tons).
  (e) Monitors (3000 to 8000 tons).

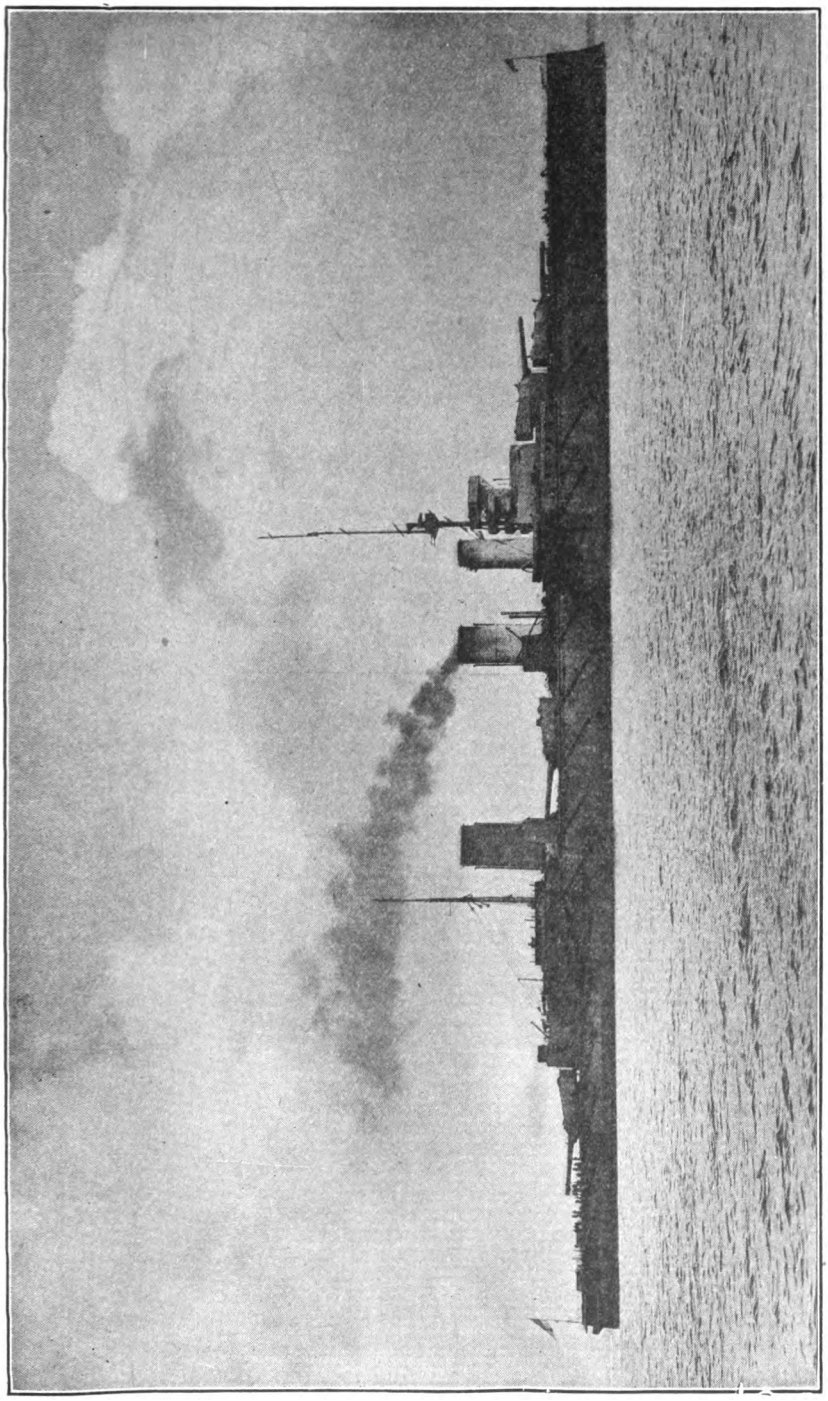
(2) Unarmored ships, including:
  (a) Protected cruisers.
  (b) Scout cruisers.
  (c) Gunboats.
  (d) Torpedoboat destroyers.
  (e) Torpedoboats.
  (f) Submarines.

(3) Auxiliaries, such as fuel ships, repair ships, hospital ships, tugs, mine layers, and other special service boats.

Q. What is the purpose of each class and what are the characteristic features of each?

A. The *dreadnought* is the most formidable type of war vessel, and combines powerful weapons with the greatest protection possible under the limitations imposed by floating warfare. To carry the heavy guns and the massive armor necessary to give the maximum offensive and defensive power, speed has, to a certain extent, to be sacrificed. Its characteristic features are great size, moderate speed, heavy armor, heavy guns, massive appearance, low freeboard, broad beam, and large turrets. Dreadnoughts are distinguished from the older battleships by being much larger and by carrying a greater number of large (turret) guns.

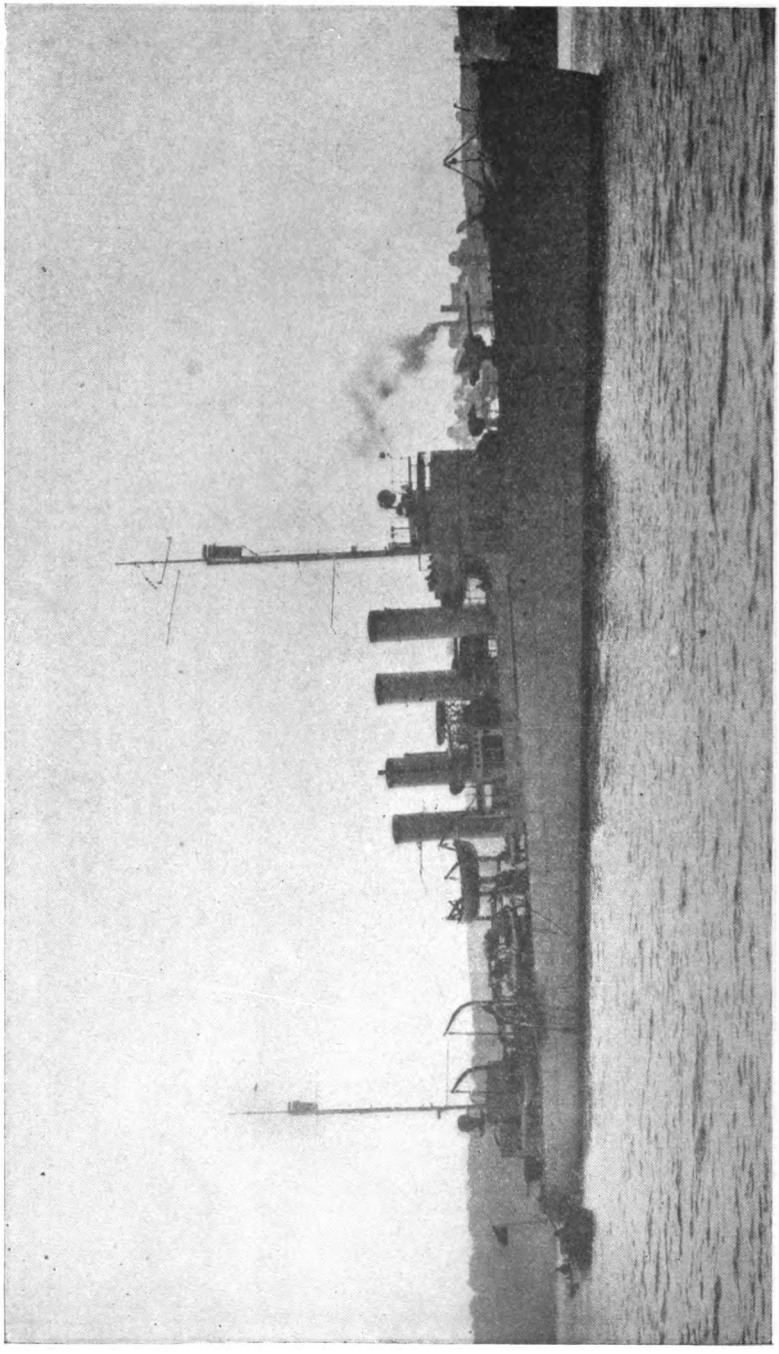
The *battle-cruiser* has the essential characteristics of the dreadnought battleship, but it is considerably longer and has considerably greater speed than the dreadnought. It carries very nearly the same number of guns and has very nearly the same armor protection as the recent types of dreadnoughts.



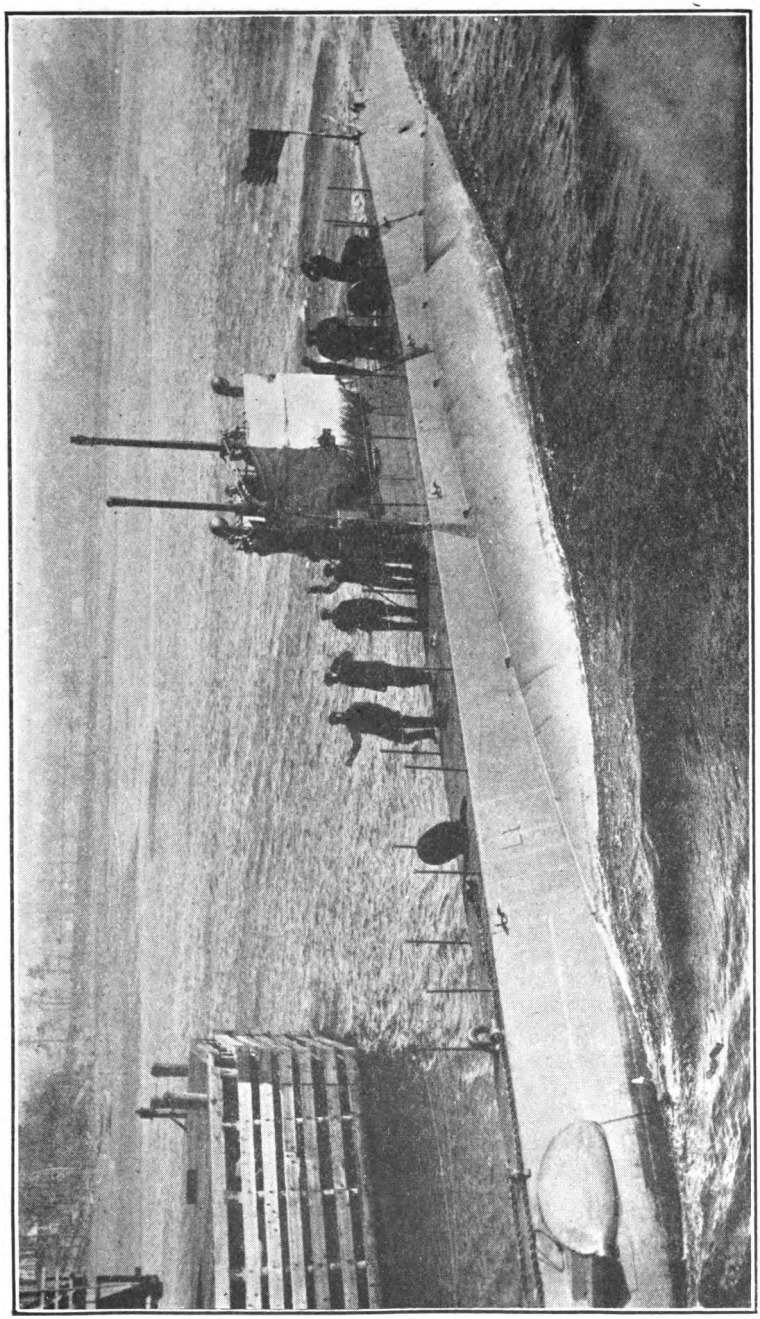
Photograph by ephem Cribb, Southsea.

H. M. BATTLE CRUISER "QUEEN MARY"

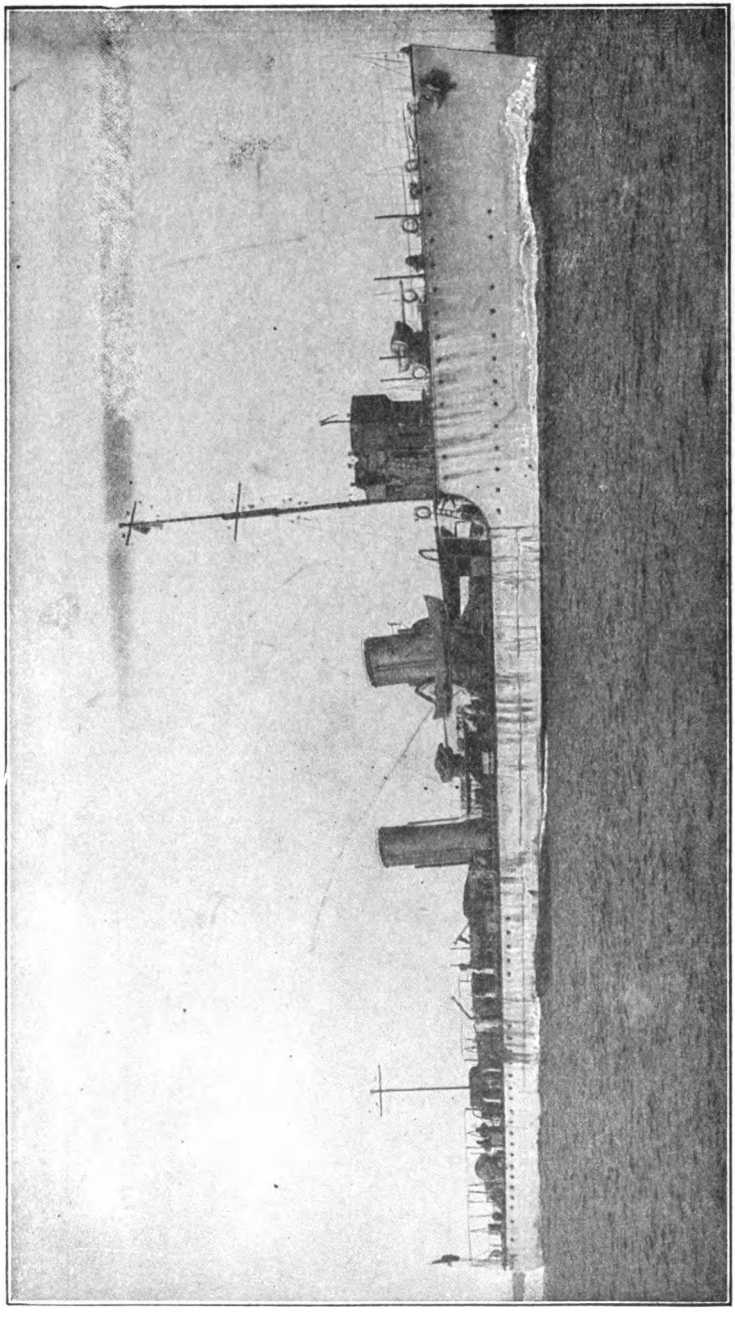
DISPLACEMENT, 27,000 TONS. BEAM, 89 FEET. DRAUGHT, 28 FEET. LENGTH OVER ALL, 690.5 FEET. ARMAMENT: 8 13.5-INCH GUNS; 16 4-INCH GUNS; 3 21-INCH TORPEDO TUBES. ARMOUR: BELT, 9 INCHES (AMIDSHIP), 4 INCHES (ENDS); TURRETS, 9 INCHES; DECK, 3 INCHES. SPEED: DESIGNED 28 KNOTS: PROBABLE 24. PARSONS TURBINE.—LE YACHT, (PARIS)



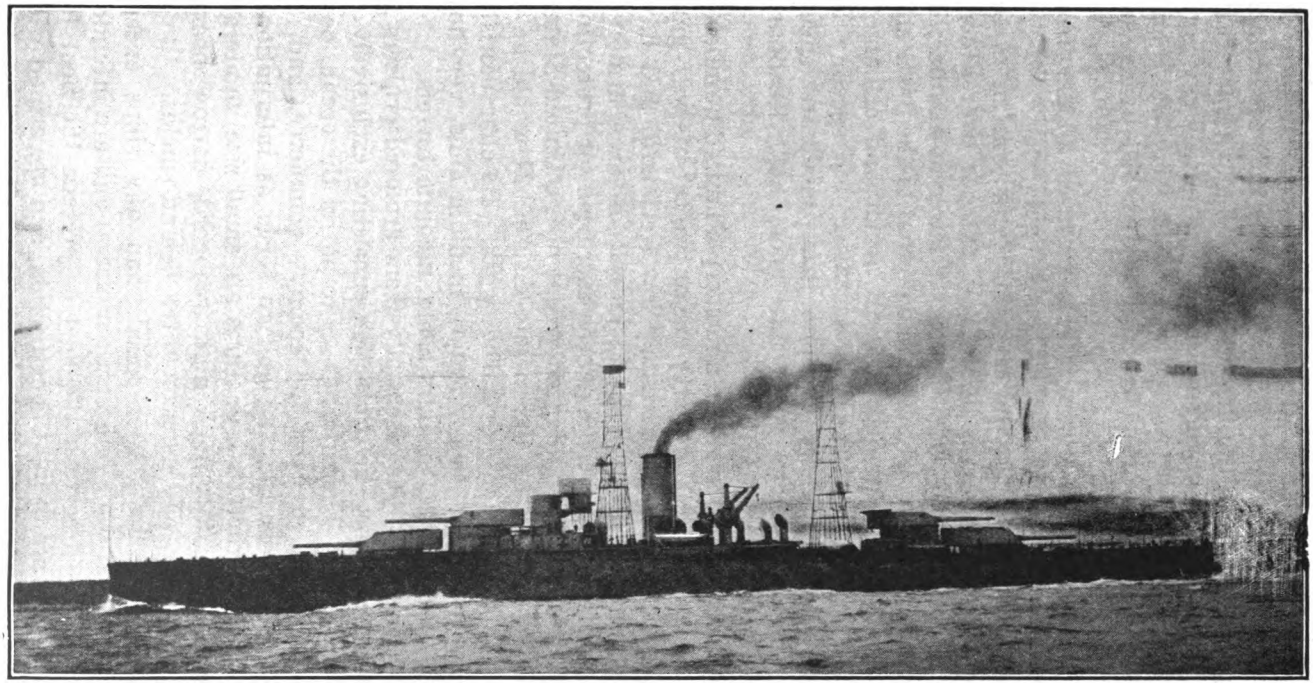
ONE OF THE NEW FLUSH-DECK UNITED STATES DESTROYERS



UNITED STATES SUBMARINE L-1



BRITISH DESTROYER LAUREL (L CLASS)
DISPLACEMENT, 807 TONS; ENGINES, 24,500 H.P.; DESIGNED SPEED, 35 KNOTS; THREE 4-INCH GUNS; TORPEDO TUBES, FOUR 21-INCH



U. S. Battleship "Nevada"

Completed January 1915. Full Load Displacement, 28,400 Tons; Length (water line), 575 Feet; Beam, 95 1-4 Feet; Mean Draught, 28 1-2 Feet; Speed, 20.9 Knots; Armament: Ten 14-inch, Twenty-one 5-inch, Four 3-pdrs. (saluting), Two 1-pdrs. Four 21-inch Torpedo Tubes, Submerged. Complement, 863.

In some cases it is difficult to distinguish the battle-cruiser from the dreadnought battleship. Battle-cruisers are designed primarily for advance skirmishing, but they are capable of taking their place in the line of battle. The characteristic features are great size, great speed, heavy armor, heavy guns, massive appearance (although the lines are somewhat finer than those of a battleship), low freeboard, broad beam, and large turrets.

Of the *battleship* the characteristic features appear from what has been said above of the dreadnought.

The *armored cruiser* has the essential characteristics of the battleship, but its armor is lighter and extends over a comparatively smaller area, and its guns are fewer in number; its speed, however, exceeds by several knots that of the battleship of the same period. In other words, armor and armament have, to a certain extent, been sacrificed for speed. Its characteristic features are medium size, moderate speed, medium armor, medium guns, fine lines, high freeboard, medium beam, medium turrets.

Monitors are heavily armored and carry a limited number of guns of large caliber. They carry one or two turrets with guns of large caliber, have an extremely low freeboard, and have heavily armored sides. The maindeck is also armored. Speed and offensive power have been sacrificed for protection. The type has never been adopted except in the United States, and in this country it has fallen into disuse. It would be of value only in coast defense or harbor work. Its characteristic features are low speed, heavy armor, medium guns, very low freeboard, medium size, medium beam, medium turrets.

Protected cruisers differ essentially from armored cruisers in having no side armor, the protection consisting exclusively of a protective deck. Their purpose is to patrol the ocean, convoy merchantmen, prey on the enemy's commerce, and, in peace time, to show the flag and to serve as international police. Their characteristic features are small size, moderate speed, small guns, fine lines, high freeboard, narrow beam, large coal capacity, and guns mounted behind shields.

Scout cruisers have higher speed than any ships except torpedo craft (and some late battle-cruisers) and are intended to cruise in company with the fleet or precede the fleet for scouting. They are of light construction, and are armed with guns of power adequate only to repel small craft. Their characteristic features are great speed, small guns, fine lines,

high freeboard, narrow beam, no armor (generally), and guns behind shields.

Gunboats may be classed as small cruisers. They serve in peace time for patrol and police duty, and, in war time, for picket duty, etc. There are special types, called river gunboats, which are built with light draft for service up rivers and in shallow harbors. All have small size, low speed, no armor, high freeboard, and a few small guns.

Destroyers were originally built to operate against torpedoboats, but soon appropriated to themselves the functions of the latter and are now, together with submarines, the chief medium of torpedo attack on large vessels. They are of extremely light construction and are built largely with a view to obtaining high speed. They have no armor, great speed, small guns (few in number and mounted behind shields), high bow, and torpedo tubes, and to reduce weight to a minimum they carry only necessities.

Torpedoboats were designed for torpedo attack on large vessels, are smaller than destroyers, and appeared first. They are no longer built and are used only in coast defense and harbor operations. Their characteristic features are great speed, small size, no armor, torpedo tubes, and few guns (small and behind shields).

Submarines are designed to operate beneath the water in torpedo attack, and have moderate speed, no armor, torpedo tubes, and no guns (although the latest types carry two rapid fire guns).

APPENDIX "A"

EXAMINATION FOR GUNNERS AND FOR SPECIAL RATINGS

EXAMINATION FOR GUNNERS

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

806. Boards of examination will be convened annually in each coast defense command by the coast defense commander, to meet, if practicable, just prior to, or just after the close of the indoor instruction period. Separate boards may be convened for the examination of candidates for first and for second class gunners, and separate boards may be convened for the different forts in a coast defense command. Each board will consist of three coast artillery officers. When a member of the board is a company commander he will be relieved by another officer during the examination of candidates from his company.

807.* For purposes of instruction and examination, enlisted men of the Coast Artillery Corps not belonging to companies or batteries, upon application, will be attached to convenient organizations, and upon qualification will be classified as gunners.

Enlisted men of the Coast Artillery Corps on duty outside of a coast defense command may be examined by one or more coast artillery officers with whom they are serving,or by coast artillery officers designated by the department commander, and, if found qualified, will be announced as gunners by the department commander.

When a mine planter or cable ship is assigned to a coast defense command, the coast artillery enlisted men assigned to the vessel may be examined by the officers on duty with the vessel, and, if found qualified, will be announced as gunners by the coast defense commander.

808. A candidate to be eligible for qualification as first-class gunner must have qualified previously as second-class gunner, through both qualifications may be made at the same examination.

809. The examination of gunner candidates will be held, as far as practicable, at such places as the material pertaining to the subject in hand is located, and will be made as practicable as possible. In determining the qualifications of candidates, credit will be given for practical knowledge of subjects, rather than for text-book answers to questions.

810. The qualifying mark for classification as first or second class gunner will be in each case not less than an average of 75 per cent. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on subjects for which he has already been examined, increased by the maximum allowed for the remaining subjects, is less than 75, he will be disqualified and his examination will be discontinued. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on the subjects in which he has already been examined is 75 or more, he will be qualified without any further examination.

811. The board will keep a record of its marks during the examination,

* See C. C. A. D. R. Nos. 3, 4, and 5.

but these marks will not be published in orders. The report of the board on each company will be sent as soon as practicable after the completion of the examination to the coast defense commander, who will publish an order announcing the names of those who have qualified as first and second class gunners, and the date of qualification (the date of the completion of the company examination being taken as the date of qualification).

812. The scope of the examination for the first and second class gunners and the relative weights to be given the subjects will be as follows:

For candidates in companies assigned to coast defense:

For second-class gunners:

(*a*)	Service of the piece (practical). This will include an actual drill at the battery in which the candidate will in turn perform the duties of various numbered cannoneers, the range setter, the chief of breech, the elevation setter (mortars only), and the azimuth setter (mortars only), or as many of those duties as the board may direct	40
(*b*)	Nomenclature of the various parts of the gun and carriage	5
(*c*)	Action, adjustment, and care of the various parts of guns and carriages	20
(*d*)	Powders, projectiles, primers, and fuses	10
(*e*)	Cordage, gins, shears, and jacks	10
(*f*)	United States magazine rifle	15
		100

For first-class gunners:

(*a*)	The azimuth instrument (theoretical, 5; practical, 10)	15
(*b*)	Duties in the plotting room (theoretical, 20; practical, 30). The candidate will act in turn as Nos. 1, 2, 3, 4, and 5 while tracking a moving target (if practicable), or in as many of those positions as the board may direct	50
(*c*)	Aiming and laying guns and mortars, practical	15
(*d*)	Time-range board (guns) and time-azimuth board (mortars), practical	10
(*e*)	Definitions, C.A.D.R.	5
(*f*)	Warships, characteristics feature	5
		100

The examination of candidates for first-class gunners of organizations assigned exclusively to rapid-fire guns not provided with separate position finding system will include the following head in lieu of those given under (*b*) and (*d*).

(*b*) (*d*)	Subcaliber firing	60

The examination in subjects (*a*), (*b*), (*c*), and (*d*) for both second-class and first-class gunners will be confined to the materiel of that part of the defense to which the company is assigned. If no azimuth instrument is included in the battery equipment, the instrument used in the instruction will be used in the examination.

EXAMINATION FOR SPECIAL RATINGS

813. In each company of coast artillery, examinations will be held by the company commander under the direction of the fire or mine commander

at such times as the latter may prescribe, for the purpose of determining enlisted men who are qualified for appointment to rated positions.

814. Records will be kept in each company in the form of eligible lists for each rated position to which enlisted men of the company may be appointed.

815. Examination for rated positions will be confined to first-class gunners or enlisted men who have once been classified as first-class gunners. Candidates who pass with an average of 75 per cent any of the examinations prescribed for rated enlisted men will be carried on the qualified list for appointment to the corresponding rated position for a period of one year from the date of examination.

816. Enlisted men on the qualified list for a rated position will be classified as first-class gunners from the date of qualification and so announced in coast defense orders, and such classification will be continued for the time they are entitled to remain on such qualified list. When a man's term of qualification for any rated position expires, he may be continued in such rated position or on the corresponding qualified list by passing a new examination for such rated position, and his classification as first-class gunner will be continued without further examination.

817. The same enlisted man may be carried on several eligible lists provided he passes satisfactorily the prescribed examinations for such rated positions.

818. Prior to the examination for the rated positions of observers, first or second class, or gun pointer, the candidates will be examined by the post surgeon for defective vision, and no candidate will be rated for these positions who has any defect in vision which would impair his efficiency.

819. An enlisted man holding a rated position need not be required to take the examination for that position until the termination of the one-year period from the date of his last classification as a first-class gunner, unless his qualifications for the position he holds have not been established to the satisfaction of the fire or mine commander concerned or the coast defense commander, in which case he will be required to take the examination for that position at such time as may be prescribed by the fire or mine commander concerned. In the event of his failure to pass satisfactorily the prescribed examination, he will be disrated immediately by the coast defense commander.

820. The scope of the examination for each of the rated positions will be as follows:

GUN COMMANDER AND GUN POINTER

I. Definitions C.A.D.R.

II. Gun and carriage.
   (a) Nomenclature, purpose, and action of several parts.
   (b) Packing stuffing boxes and cleaning recoil cylinders.
   (c) Adjustment of—
   Quadrant elevation device, sight standard, throttling valve, gas-check pad, elevating gear, grease cups, and firing mechanism.
   (d) Care and preservation, including care of hand counter-weights, oiling, and painting.

III. Powders, projectiles, fuses, and primers.
   (*a*) Blending powder and preparation of powder charges.

(*b*) Filling and fusing projectiles.
(*c*) Painting projectiles.

IV. Preparations for service or subcaliber practice.
V. Service of the piece.
(*a*) Duties of each member of the gun section under all conditions.
VI. Precautions for safety at the battery.
VII. Pointing.
(*a*) Methods of pointing and pointing tests.
(*b*) The telescopic sight (the quadrant for mortars).
(*c*) Emergency system and salvo points.
(*d*) Bore sighting and orientation.
VIII. Regulations governing service and subcaliber practice so far as they affect the service at the emplacements.
IX. Mounting and dismounting guns and carriages.
X. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

PLOTTER

I. Definitions C.A.D.R.
II. Position finding system.
(*a*) Detailed knowledge of system employed at the battery.
(*b*) Indication and identification of targets.
(*c*) Duties of each member of the range section under all conditions.
(*d*) Emergency system and salvo points.
III. Position finding apparatus.
(*a*) A detailed knowledge of adjustments and use of all position finding apparatus used in the plotting room.
IV. Elementary gunnery.
(*a*) Explanation of the several corrections to be applied to the observed range to obtain the corrected range.
(*b*) Effect on the flight of the projectile of variations in the density of the air; the direction of velocity of the wind.
(*c*) Use of trial shots and application of data obtained from them (problem).
V. Preparation of target-practice records.

OBSERVER (FIRST OR SECOND CLASS)

I. Definitions C.A.D.R.
II. Position finding system.
(*a*) Detailed description of that in use at the battery.
(*b*) Indication and identification of targets.
(*c*) Emergency system and salvo points.
III. Position finding apparatus.
(*a*) A detailed knowledge of adjustment and use of all observing instruments and range finders in use at the battery.
(*b*) Use of the telephone.
IV. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

APPENDIX "B"

DEFINITIONS

Note. These definitions are inserted here for the benefit of soldiers who wish to learn all they can of their profession. Instructors and examiners should not require the soldier to learn all of these definitions, but should be guided by the list of terms given in the body of the book under the head "Definitions" in the instruction for 1st class gunners; for an examiner to go beyond these limits (except in case of definitions learned in studying some other subject, as "fuses" or "primers") is to be unjust to the soldier.

These definitions are taken from publications of the Coast Artillery Board as they are more up to date than the definitions contained in the 1914 Drill Regulations, and presumably will eventually supercede the latter definitions.

Aeroscope.—A device used in the meteorological station and the fire, mine, and battery primary stations for the indication of the azimuth of the wind in degrees, the velocity of the wind and the density of the atmosphere by reference numbers. In the latter stations it may also contain a dial indicating the height of tide.

Aiming.—See **Pointing.**

Altitude.—Vertical distance above or below sea level or map datum.

Ammunition.—In general, is the term applied to all elements, including the projectile itself, used to send a projectile from the bore of a gun. **Round of Ammunition.**—Those elements used in firing a gun once. It is composed of:

Primer.—A device used to ignite the propelling charge.

Propelling Charge.—The explosive placed behind the projectile in the bore of the gun and used to impart motion to the projectile.

Projectile.—A missile thrown from a gun by the propelling charge to serve as a carrier for high explosives, gas, smoke, etc., which it is desired to carry to and explode or scatter at a definite point.

Bursting Charge.—The explosive placed on the cavity of the projectile and designed to explode with sufficient violence to rupture the shell and hurl the fragments with destructive effect.

Fuse.—A device attached to the projectile to cause the detonation of the shell at the time or under the circumstances desired.

Kinds of Ammunition.—The relation of the above elements of a round of ammunition to each other determines the kind of ammunition. This division is as follows:

Fixed Ammunition.—In which the primer, propelling charge, and projectile are in a single metal container, as in the Springfield rifle cartridge. This type of ammunition is used in 3-inch, 4.7-inch, 75-mm. guns and 37-mm. guns.

Semi-Fixed Ammunition.—In which the primer and propelling charge are in a single metal container, and the projectile is loaded separately. This type is used in the 4.7-inch howitzer.

Separate Loading Ammunition.—In which the primer, propelling charge, and projectile are each loaded as a separate unit. This type is used in guns of 5-inch caliber and up, 155-mm. gun, and howitzers of 8-inch caliber and up.

Ammunition Recess.—The space built in the parapet wall at loading platform level for the temporary storage of ammunition.

Ammunition Truck.—A truck for carrying projectiles to the breech of cannon.

Anemometer.—An instrument used in the meteorological station to determine the velocity of the wind.

Aneroid Barometer.—A watch-shaped instrument used in the meteorological station to determine the pressure or density of the atmosphere.

Angle of Departure.—The angle between the plane of site and the line of departure. The **Quadrant Angle of Departure** is the angle between the horizontal plane at the muzzle and the line of departure. Angles of departure are positive when measured upward from the horizontal plane.

Angle of Depression.—The angular depression of the line of site below the horizontal plane at the muzzle.

Angle of Elevation.—See **Elevation.**

Angle of Fall.—The angle between the horizontal plane at the point of fall and the line of fall.

Angle of Impact.—The angle between the line of impact and the plane tangent to the surface at the point of impact.

Angle of Incidence.—The angle between the line of impact and the normal to the surface at the point of impact.

Angle of Site.—The angle between the line of site and a line joining the piece and a point vertically above or below the target at an altitude equal to that of the piece.

Apron.—The reinforced concrete or metal portion of the superior slope of a parapet and the interior slope of a mortar pit designed to protect against blast. Also called **Blast Slope.**

Armament.—Cannon of various sizes and powers, including their carriages. In the Coast Artillery service armament is classified as primary, and secondary.

Armor.—The protection afforded the sides and decks of warships.

Armor Piercing Projectiles.—Shot and shell designed to perforate heavy side and turret armor of war vessels.

Atmosphere Board.—A device pertaining to the equipment of the meteorological station. A graphic table by means of which the reference numbers to be recorded on the dial of the aeroscope indicator can be determined from readings of the barometer and thermometer.

Axis of Gun.—The axis, or central line, of the bore.

Azimuth.—In harbor defense usage, a horizontal angle measured in a clockwise direction from the south point of the true meridian through the observer.

Azimuth, Y.—See **Y-Azimuth.**

Azimuth Difference.—The difference between the two azimuths of a point as measured from two other points.

Backlash.—The play between a screw and its nut where the latter is loosely fitted. A reverse movement of any part of a mechanical gear, caused by irregularities, without moving other connecting parts.

Baffle Plate.—A thin plate used to deflect or retard the course of gases of drill primers. It is attached to the front face of the breech-block.

Base Line.—In mobile warfare, the line joining the base piece and the base point. In harbor defense operations, a line used in position finding, the horizontal length and direction of which have been determined. The observing stations at the ends of a base line are called **Base End Stations.**

Base Piece.—In mobile warfare, the piece of a battery whose location is used in determining the firing data for the battery.

Base Point.—A well determined point in the field of fire of a battery at which the base piece is pointed in the original orientation of the battery.

Base Ring.—The metal ring which is bolted to the concrete of the emplacement and which supports the weight of the gun or mortar carriage.

Ballistics.—The science of the motion of projectiles and of the accompanying phenomena. **Interior Ballistics** deals with the motion of the projectile while in the cannon or small arm and with the physical and chemical phenomena that cause and attend its motion. **Exterior Ballistics** deals with the motion of the projectile in the air.

Battery.—One or more guns or mortars grouped with the object of concentrating their fire on a single target and of being commanded directly by a single individual, together with the entire structure erected for their emplacement, protection, and service.

Battery Manning Table.—A table containing a list of names detailing the personnel of a battery to their posts.

Battery Parade.—The area in rear of the emplacements of a battery where the sections form.

Battle Chart.—A chart used in fort, fire, or mine command stations,

showing the water area covered by the armament of their respective commands.

Biting Angle.—The maximum angle of incidence at which penetration of armor is secured.

Blending.—The process of mixing powders of the same or different lots so as to obtain charges of uniform characteristics.

Bomb-Proof.—A term applied to military structures of such thickness and strength that shells cannot penetrate them.

Bore.—The interior of the cannon forward of the front face of the breech block. (This face is that of the breech block proper, not including the mushroom head.) It is composed of the gas check seat, the powder chamber, the centering slope, the forcing slope and the rifled portion called the **Main Bore.** The **Length of Bore** is the distance from the front face of the breech block proper to the face of the muzzle measured along the axis of the bore.

Bore-Sighting.—In coast artillery, the process by which the line of sight and axis of the bore prolonged are caused to converge on a point at or beyond mid-range.

Bourrelet.—That part of a projectile between the main body and the head, which includes the beginning of the ogive.

Breech.—The rear end of a cannon. In small arms, the rear end of the barrel.

Breechblock.—The metal plug which closes the breech of a cannon.

Breech Bushing.—That part of the breech on the interior surface of which the threaded and slotted sectors of the breech recess are formed.

Breech, Face of.—The rear plane of a cannon perpendicular to the axis of the bore.

Breech Mechanism.—The breechblock, obturating device, firing mechanism, and all parts used in operating the breechblock of a cannon.

Breech Recess.—The opening in a cannon which receives the breechblock.

Breech Reinforce.—The part of a cannon in front of the breech and in rear of the trunnion band.

Bushing.—(Machine). A hollow cylinder forced into an opening to provide a better wearing surface, or one that may be easily replaced when worn.

Caliber.—The diameter of the bore in inches, measured between diametrically opposite lands. It is the minimum diameter of the rifled portion of the cannon.

Cannon.—Artillery weapons from which projectiles are thrown by the force of expanding powder gases. (See Gun or Piece.)

Cannon are of three classes: Guns, mortars, and howitzers.

Guns are long (generally 30-50 calibers), have flat trajectories, and are ordinarily used for direct fire, with high velocities.

Mortars are short (about 10 calibers), and are used for high-angle fire (above 45°), with low velocities.

Howitzers are short guns and are used for curved fire (not exceeding 45°), with low velocities.

Built-up cannon are made by shrinking forgings (jacket and hoops) over an inner tube. Wire-wound cannon are made by winding wire under tension around a tube; a jacket and hoops may be shrunk over the wire-wound tube.

Cannoneer.—Any man employed in the "service of the piece."

Cap-Square.—That part of a gun or mortar carriage which fits over the trunnions and holds the trunnion in the trunnion bed.

Capped Projectile.—A projectile having a metal cap over its point to give stability to the point of **Armor Piercing Projectiles** when commencing penetration and to give the armor an initial shock at the point of penetration, or to cut down the air resistance of projectiles provided with a **ballistic cap.**

Carriage or Mount. The means provided for supporting a cannon. It includes the parts for giving elevation and direction, for taking up the recoil on discharge and for returning the piece to the firing position.

Carriage, Fixed (Seacoast).—A mount provided for guns and mortars in permanent works and not designed to be moved from place to place.

Those used for fixed coast artillery cannon may be divided into the two following classes, depending upon the nature of cover afforded by the emplacements.

Barbette: Where the gun remains above the parapet for loading and firing. Barbette carriages are used for guns of 3-inch or greater caliber. The pedestal mount is a type of barbette carriage used for guns up to 6-inches in caliber.

Disappearing: Where the gun is raised above the parapet for firing and recoils under cover for loading. This mount is used for guns of 6-inch or greater caliber.

Cant.—The angle made with the horizontal by the axis of the trunnions, sometimes referred to as **slope of the trunnions.**

Calibration.—The determination of the range and deflection differences to be expected when firing two or more cannon under identical conditions of atmosphere, range and direction. Calibration corrections are the corrections necessary to compensate for these differences.

Carriages, Mobile (Seacoast).—A mount provided for guns, howitzers and mortars that is so designed that it is capable of being moved from place to place. These carriages include the following types, railway, wheel, caterpillar, truck and self-propelled mounts.

Cartridge.—A complete load of fixed ammunition (projectile, powder, and primer) as used in small arms.

Cartridge Bags.—Bags used to hold the powder charges for cannon.

Cartridge Case.—A container in which powder is sealed for shipment and storage.

Cartridge Extractor.—That part of a breech loading gun which ejects the empty cartridge case from its seat in the bore.

Casemate.—An obsolete form of bombproof chamber, usually of masonry, in which cannon were placed to be fired through embrasures or portholes; or one capable of being used as a magazine. See **Mining Casemate.**

Center of Impact.—The mean position of the points of impact of a series of shots.

Centering Slope.—The conical part of the bore between the powder chamber and the forcing slope. It is for the purpose of bringing the axis of the projectile in line with the axis of the bore.

Charge.—The explosive placed in a gun or mortar behind the projectile as a propellant (propelling charge). Also the explosive placed in the cavity of a projectile (bursting charge).

Charge (or Powder) Section.—One of the component parts of a charge when the charge is made up of two or more separate parts.

Chase.—That part of a cannon in front of the trunnion band.

Chassis.—That part of a gun carriage upon which the top carriage moves backward and forward. With the disappearing type of carriage the chassis carries recoil rollers and the top carriage rests upon these rollers.

Chronograph.—An instrument for graphically representing elapsed intervals of time.

Chronometer.—An instrument for accurately measuring time.

Circular (Traversing, Elevating, etc.) Rack.—A straight or slightly curved bar with teeth on its edge arranged to mesh with those on a wheel or pinion, which is to drive or follow it.

Clinometer.—An instrument for measuring accurately the inclination of the axis of the bore to horizontal.

Clinometer Rest.—The support for a clinometer inserted in the muzzle of the gun; it is also called **Bore Plug.**

Collar.—(Machine). An enlarged cylindrical portion of a shaft, or a cylindrical ring or sleeve secured upon the shaft, in either case to serve as an abutment for securing something or preventing longitudinal movement of the shaft itself.

Combustion.—The burning of a grain of powder or wood or coal, from the surface of ignition inward or outward or both.

Communications.—Means of transmitting orders or messages through the tactical chain of artillery command. In another sense it includes all routes, such as roads, railroads, etc., by which an army communicates

with its base, or by which several parts of an army communicate with each other.

Corridor or Truck Corridor.—The elevated passageway in rear of the traverse connecting adjacent gun emplacements at the loading platform level.

Counterweight.—The weight used in bringing a gun on a disappearing carriage to the firing position, and to take up part of force of recoil. The pit in the gun platform for the reception of the counterweight is called the counterweight well.

Critical Dimension.—A term used in connection with powder grains. It is the dimension or thickness of the web between the perforations in a multi-perforated grain. Also called **Least Dimension.**

Crusher Gauge.—A device inserted in the mushroom head of the breechblock, or in the bottom of the bore, to determine the maximum pressure of the bore. Commonly called **Pressure Gauge.**

Danger Space.—The part of the range within which a target of a given height would be hit by a projectile. The maximum which is all danger space is called the **Danger Range.**

Datum Point.—A fixed point, the azimuth and range of which, from one or more observing stations, have been accurately determined.

Deflection.—The angle between the sighting plane and the vertical plane through the axis of the bore.

Deflection Board.—A device for determining the algebraic sum of the deflection corrections for wind, drift and travel of target during the time of flight and the predicted interval. It is used to determine the reference numbers for the deflection scale of the sight in Case I and II, and the azimuth correction reference number in Case III; and, for mortars, the corrected azimuth.

Deflection Scale.—A scale provided on sights, graduated in degrees or mils for the purpose of laying the piece in direction or obtaining and applying correction for deflection.

Degree.—One three-hundred-and-sixtieth part of a circumference. Thus 90 degrees make a right angle.

Delivery Table.—The hoist table from which the projectiles are delivered to the ammunition trucks.

Density of Loading.—The ratio of the weight of the powder charge to the weight of a volume of distilled water at the temperature of maximum density (39°.2 F.) which will fill the powder chamber. The formula for computing it is

$$\triangle(\text{density of loading}) = 27.68\ w/v,$$

in which w is equal to the weight of the powder in pounds and v the volume of the chamber in cubic inches.

Detonation.—An explosion in which the conversion takes place with rapidity producing a crushing or shattering effect.

Deviations.—Divergences (or components thereof) with respect to the center of the target, of points or centers of impacts or of points where trajectories pierce a reference plane. Deviations should be differentiated from errors which are divergences of shots with respect to the center of impact.

Difference Chart.—A graphic device by means of which the range and azimuth of a target from one gun or station are obtained when the range and azimuth from some other gun or station are known.

Directing Point.—In harbor defense, a point for which the basic position or firing data is determined. When the pintle center of one piece is taken as the directing point of a battery such piece is called a **directing gun.**

Dispersion.—As generally used in gunnery, dispersion is the distribution of points of impact about their mean position or center of impact.

Dispersion Ladder.—A diagram of eight successive sections each equal in width to one probable error, and two unlimited end sections with percentages marked as follows:

½% 1½% 7% 16% 25% 25% 16% 7% 1½% ½%

This indicates the approximate per cent of impacts to be expected in each section when the center of impact is the center of the diagram.

Drift.—The divergence of the projectile from the plane of departure due to the rotation of the projectile and the resistance of the air. Where

the twist of the rifling is right handed, as in our service, the resultant drift is always to the right. It may be expressed either in linear or angular units.

Elevating Band.—A band around a gun near the breech to which are attached the elevating arms. By means of the elevating gearing, the elevating arms give elevation to the gun.

Elevation.—The angle between the plane of site and the line of elevation. Positive when measured upward from the plane of site. Symbol φ', read **phi prime. Quadrant elevation** is the angle between the horizontal plane at the piece and the line of elevation; positive when measured upward from the horizontal plane. Symbol φ, read **phi.**

Emplacement.—That part of the battery pertaining to the position, protection, and service of one gun, mortar, or group of mortars.

Equalizing Pipe.—A pipe connecting the corresponding ends of two recoil cylinders for the purpose of equalizing the pressure therein.

Erosion.—The gradual enlargement and scoring of the bore due to the action of powder gases on the metal of the lands and grooves. (In foreign armies *erosion* as here defined is referred to as the wear of the gun and the term *erosion* is used to designate deep and sudden pittings of the bore.)

Errors.—Divergences (or components thereof) with respect to the center of impact of points of impact or of points where trajectories pierce a reference plane. Errors should be differentiated from *deviations* which are divergences of points of impact or centers of impact with respect to the target.

Explosive.—Any substance by whose decomposition or combustion, gas is generated with great rapidity. Military explosives consist of solids or liquids which, through the application of heat or shock, are susceptible of being converted suddenly into gases, through chemical reactions.

Explosive Compound.—An explosive whose ingredients are united chemically. Nitro-glycerine and guncotton are explosive compounds.

Explosive Mixture.—An explosive whose ingredients are mixed mechanically. Gunpowder is an explosive mixture.

Explosion.—Rapid conversion of a substance into a large volume of hot gases and solids.

Exterior Crest.—The line of intersection of the superior and exterior slopes.

Exterior Slope.—The outer slope of the parapet of a battery.

Field of Fire.—The area covered by the armament of a battery, or with reference to a single gun, it is the area covered by that gun.

Fifteen-Pounder.—Term applied to a 3-inch rapid fire gun. It denotes the proper weight of projectile for the piece.

Fifty Per Cent Zone.—A zone bounded by two parallel lines equidistant from the center of impact and one probable error therefrom. Fifty per cent of the points of impact of a series of shots fired under uniform conditions with uniform pointing may be expected in such a zone. (See dispersion ladder). The area common to the fifty per cent lateral zone and the fifty per cent longitudinal zone is the **Twenty-Five Per Cent Rectangle.**

Fire Control.—The exericse of those functions of command connected with the concentration and distribution of fire, including the assignment and identification of targets. Ordinarily **fire control** is exercised by fire, battalion or other higher commanders. When battery commanders' action is ordered, or becomes necessary, battery commanders exercise independent fire control.

Fire Control Diagram.—A diagram showing the assignment of batteries to fire or mine commands, the division of fort commands into fire and mine commands, the assignment of searchlights, and the system of communications for the tactical chain of command in any particular coast defense command.

Fire Control Installation.—The matériel after installation which is employed in the fire control, fire direction and position finding service of any unit is called the **fire control installation of that unit.**

Fire Direction.—The exercise by the commander of a battery or other fire unit of those functions of command necessary to secure accuracy of fire on an assigned target.

Fire Discipline.—The efficiency of the personnel in action which

involves accuracy and altertness resulting from organization drill and coordinated effort.

Fire, Kinds of:

(a) **Direct Fire.**—Fire with angles of elevation not exceeding 20°.

(b) **Curved Fire.**—Fire with angles of elevation from 20° to the elevation corresponding to the maximum range.

(c) **High Angle Fire.**—Fire with angles of elevation greater than the elevation corresponding to maximum range.

(d) **Indirect Fire.**—A term sometimes used in the light artillery service to designate fire by indirect pointing.

Fixed Mount.—A mount or carriage provided for guns and mortars in permanent works and not designed to be moved from place to place.

Fixed Light.—A searchlight intended to demarcate the outer limit of a battle area and illuminate any target entering it.

Forcing Slope.—The part of the bore immediately in front of the centering slope. The rifling begins at the junction of the centering slope and the forcing slope. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating bands. The lands attain their full height at the front end of the forcing slope.

Fork.—The change in elevation necessary to produce a change in range equivalent to four times the field range probable error.

From Battery.—The position of a gun when withdrawn from its firing position.

Fulminate.—A very sensitive explosive compound used in fuses, primers and caps.

Fuse.—A device attached to a projectile for the purpose of causing the explosion of the bursting charge either by impact or at the expiration of a certain time of flight. Fuses are classified according to construction, as ring resistance, combination, time and percussion, centrifugal, and detonating; they are classified according to location in the projectile as point and base.

Gallery.—Any passage covered overhead and at the sides.

Garrison Gin.—A lifting tackle used in mechanical maneuvers of coast artillery armament.

Gas Check.—The essential mechanical features of an obturator which enables it to prevent the escape of gas.

Gas Check Seat.—That part of the bore of a cannon where the gas check pad rests when the breechblock is closed.

Gearing.—A train of toothed wheels for transmitting motion.

Spur Gear.—A gear with a cylindrical pitch surface, the faces of the teeth being parallel to the axis of the wheel; used for transmitting motion between parallel shafts.

Bevel Gear.—A gear with its pitch surface a frustrum of a cone; used for transmitting motion between two shafts which would intersect if prolonged.

Worm Gear.—A gear of a worm and a worm wheel working together.

Grooves.—In ordnance, the spiral hollow cuts made in the surface of the bore.

Gun or Piece.—A general term applied to any fire arm from which a missile is propelled by the force of the expanding gas. In a restricted sense, the term **gun** is applied as defined under **cannon.**

Gun Displacement.—The horizontal distance in yards from the vertical axis of the directing gun to the center of any other gun of the battery, or from the directing point to the center of any gun of the battery.

Gun Levers.—Two steel arms on a disappearing carriage, which support the gun at one end and the counterweight at the other end. The gun trunnions rest in trunnion beds on the gun levers, and the counterweight is suspended from a steel crosshead which joins the ends of the gun levers. The gun levers are pivoted near their middle upon a gun-lever axle which rests in bronzed bushed axle beds in the top carriage.

Gun Platform.—That part of a battery upon which the gun carriage rests.

Gun Pointer.—A specially qualified member of a gun section charged

with the proper aiming or laying of a gun, or the chief of a mortar detachment who supervises the loading and laying of a mortar.

Gunner's Quadrant.—An instrument usually used in laying mortars to give quadrant elevation by either applying it at the breech or muzzle.

Gunnery.—The art and science of operating guns.

Height of Site.—The altitude of a piece above or below the assumed datum; for cannon emplaced to cover water areas, their altitude above mean low water, except in the Pacific insular possessions where the datum is mean lower low water.

Hoop.—A forging superimposed upon the jacket, tube or other hoops of a cannon.

Hygrometer.—An instrument for measuring the degree of moisture in the atmosphere.

Ignition.—The setting on fire of a powder grain or charge.

Igniting Charge.—A charge of black powder placed in contact with the propelling charge to quicken inflammation; a **base igniter** if quilted into each end of each charge, and a core **igniter** in the form of a tube connecting both ends of a charge.

In Battery.—The term used to indicate that a gun is in its proper position for firing.

In Commission.—The term used to indicate those batteries to which personnel is assigned.

In Service.—The term used to indicate those batteries to which personnel is assigned and at which daily drills are held.

Inflammation.—The spread of the flame from grain to grain of the charge, or point to point of the grain.

Initial Velocity.—See muzzle velocity.

Interior Crest.—The line of kntersection of the interior wall or slope with the superior slope.

Interior Slope or Wall.—The inner slope or wall of gun parapets or mortar pits.

Jacket.—The principal forging shrunk on the breech end of a tube of a cannon.

Journal.—The portion of a shaft or axle which works within the bearings.

Journal Box.—(Ry.) A cast iron box which contains the car axle journal, together with the journal bearing, oil packing, etc.

Lands.—In ordnance, the surface or ribs of the bore between two adjacent grooves of the rifling.

Lanyard.—A strong cord to one end of which a brass hook is attached. Used for exploding the friction primer when the piece is to be fired. See **Safety Lanyard.**

Lateral Fork.—The change in deflection necessary to produce a lateral displacement of the point of impact equivalent to four times the field deflection probable error.

Line of Collimation.—The line in which the optical axis of the telescope should be when properly adjusted. The line of collimation and the line representing the axis of the telescope, when in proper adjustment, coincide.

Line of Site.—A straight line joining the piece and target.

Load.—A single charge of powder and a single projectile as combined for firing in a gun or mortar.

Loading Platform.—That surface upon which the cannoneers stand while loading the piece.

Loading Tray.—A device used to protect the breech recess while loading the projectile.

Lot.—A term used by manufacturers to designate a certain amount of explosives manufactured at one time. All of the explosive of one lot should possess uniform characteristics.

Magazine.—A room for storage of powder, primers, fuses, etc.

Maneuvering Rings.—Large cast iron rings fastened in the walls of emplacements, designed for holdfasts in mechanical maneuvers.

Mark One.—A term used to indicate the first improvement of the original model of a particular type of gun, mortar, etc.

Map Range.—The range of any point as scaled or calculated from a map.

Maximum Ordinate.—The difference between the altitude of the piece and the summit of the trajectory.

Mercurial Barometer.—An instrument used in the meteorological station to determine the pressure or density of the atmosphere.

Meteorological Message.—The message sent by a meteorological observer. It includes the barometer and thermometer readings, the atmosphere reference numbers and the velocity and azimuth of the wind.

Meteorological Observer.—An enlisted man in charge of the meteorological station.

Meteorological Station.—A station containing instruments for obtaining and sending out to the various stations data relating to the density of the atmosphere and the velocity and direction of the wind.

Mil.—One sixty-four hundredth part of a circumference. Thus 1600 mils make one right angle or 90°.

Mining Casemate.—A protected building containing the controlling mechanism of the mine defense.

Misfire.—The failure of a powder charge to explode. In case of a misfire in artillery practice the breech will not under any circumstances be opened for ten minutes, nor until the primer has been removed except when the primer is seated in the cartridge case.

Mushroom Head.—The front part of the DeBange obturator.

Muzzle.—The front end of a piece.

Muzzle (or Initial) Velocity.—The velocity the projectile is assumed to have at the muzzle of the piece. Strictly it is the velocity at the muzzle which if there were no powder blast would conform to the actual velocities measured at points of the trajectory beyond the powder blast distance. Symbol, M.V.

Nitrocellulose Powder.—The name applied to a form of smokeless powder used in modern ordnance, in which cellulose (unspun cotton waste) is the base.

Object Glass.—The glass in a telescope which is placed at the end of the tube nearest the object.

Observation Telescope.—A telescope used in target practice and in action to observe the striking points of shots.

Observer.—A member of the fire control section who is in charge of and uses an observing instrument.

Obturator.—A device for preventing the escape of gas. **Obturation** is the process of preventing the escape of gas.

Ogive.—That curve at the head of a projectile which terminates at the point.

Ordnance.—The term applied to artillery armament and the accessories and stores pertaining thereto.

Orienting Point.—A point at which an azimuth instrument may be set and from which the Y-azimuth of at least one visible point is known.

Parados.—Earthworks in rear of a battery for protection against fire from the rear. It may have interior, superior, exterior and traverse slopes.

Parapet.—That part of a battery, composed of earth, timber, stone, metal, etc., which gives protection to the armament and personnel from front fire.

Pattern.—The group of points of impact of a salvo.

Penetration.—The act or power of penetrating armor or other material. Also the distance to which a projectile sinks into armor or other material.

Perforation.—The complete piercing of armor or other material by a projectile. This term as distinct from penetration, defines the ability of the projectile to pass through armor or other material so as to be in a position to burst on the opposite side.

Percussion cap. A cap in which the method of explosion is due to a blow; used in fixed ammunition.

Piece.—See Gun.

Pintle Center.—The vertical axis about which a gun carriage is traversed.

Pinion.—A small toothed wheel in gear with one considerably larger.

Piston.—A device for receiving the pressure of, or operating upon, a

fluid in a cylinder or tube, and consists of the piston head, and the piston rod.

Pit.—That part of a mortar emplacement designated for mounting one or more mortars, usually two or four.

Plane of Departure.—The vertical plane containing the line of departure. This plane is also called the **plane of fire.**

Plane, Sighting.—The vertical plane containing the sighting line.

Plane of Site.—The plane containing the line of site and perpendicular to the vertical plane through the line of site.

Plotter.—A specially qualified enlisted man in charge of the plotting board at a fire control station.

Plotting Board.—A device used in the position finding service to quickly plot to scale the data sent from the position finding instruments, and in connection with range and deflection boards, to determine the corrected data for firing.

Plotting Room.—The room in which the plotting detachment works. It is usually located below and communicates with, the instrument room of the battery commander's station, or with the observing room of the primary station.

Point of Burst.—The point in the air where a projectile bursts or where in uninterrupted flight it would burst by the action of a time fuse.

Point of Impact.—The point where an unburst projectile first strikes the ground, the water or other material object.

Pointing.—The operation of giving a piece an elevation and a direction designed to hit a target. When pointing in direction, or in both direction and elevation, is effected by the use of a sight such operations are called **Aiming.** When pointing in elevation, or in both elevation and direction, is effected without the use of a sight such operations are called **Laying.** Thus both aiming and laying may be employed in a single pointing. When the sighting plane passes through the target, the piece is said to be directly aimed, i.e., **Direct Aiming** is used. When the sighting plane passes through an auxiliary point, the piece is said to be indirectly aimed, i.e., **Indirect Aiming** is used. **Indirect Pointing** includes both **laying** and **indirect aiming.**

Position Finder.—An instrument for locating a target.

Position Finding System.—The term applied to the system used in determining the range and direction of a target from a battery or directing point. The following systems are used in the Coast Artillery service, horizontal base, vertical base, and self contained base.

Powder Blast.—The outrush of air, gases and powder fragments from the muzzle when a piece is fired.

Powder Cases.—Cases in which powder is contained in shipment from arsenals or storage until used.

Powder Chamber.—The portion of the bore for the reception of the powder charge. The **Closed Powder Chamber** includes the total enclosed space occupied by powder, air and powder gases at the instant of firing.

Powder Chart.—A graphic chart used to determine the velocity to be expected from a given charge of powder considered as a function of the temperature of the powder.

Powder Hoist.—A device for raising powder from the magazine to the loading platform.

Power Room.—A room in the battery provided for the necessary motor generators, induction motors and switchboards.

Power Station or Plant.—The principal source of supply of energy, usually electrical, for the power system of the fortifications and stations. The plant consists of a sufficient number of direct connected units to supply all the power needed for the entire installation under conditions of full load.

Predicted Point.—A point at which it is predicted that a target will arrive at the end of an assumed interval of time. This interval of time is called the **Predicting Interval.**

Predicter.—An accessory of the plotting board used to locate the positions of the predicted and the set-forward points on the plotting board.

Preponderance.—The excess (moment) of weight of that part of the piece in rear of the trunnions over that of the front, or the converse. It

is measured by the force expressed in pounds necessary to balance the cannon when resting freely on the trunnions.

Pressure Cylinder.—A soft copper cylinder used in crusher gauges which is compressed by the explosion of the charge.

Pressure Gauge.—See **Crusher Gauge.**

Primary Armament.—The armament of the coast artillery service consisting of major caliber cannon. It includes 12-inch, 14-inch, and 16-inch guns, and howitzers and mortars 12 and 16 inches in caliber.

Primer.—The device used for igniting the propelling charge. Primers may be friction, percussion, electric, or combination (electric and friction).

Priming Charge or Igniter.—Small charges of black powder placed in contact with the powder sections necessary for the ignition of smokeless powder (See **Igniting Charge**).

Projectile.—The term applied to a missile thrown from a firearm by an explosive. The principal parts of an armor-piercing projectile are the ballistic cap, the armor-piercing cap, the nose or point, the ogive, the bourrelet, the body, the rotating band, the cavity, the base, the base plug, and the fuse plug.

Progressive Powder.—An explosive or propelling agent of low order; for example, the charcoal and nitro-cellulose powders. The explosion of powders of this kind is marked by more or less progression. The mass is ignited at one point and the combustion proceeds progressively over the exterior exposed surfaces and then at right angles to these surfaces.

Projector.—The technical name of a searchlight.

Pyramidal Target.—A material target in the form of a pyramid. covered with canvas painted vermilion. This pyramid is mounted on a float made of two parallel sills of timber, joined by transoms, two diagonal braces and a prow to which a suitable bridle is attached for towing.

Quadrant.—The quarter of a circle or the quarter of the circumference of a circle; an arc of 90 degrees. Also an instrument by means of which a gun is laid in elevation.

Quickness of burning.—The rapidity with which a grain of powder is consumed. When it is said that the powder is too quick or too slow for a gun, the quickness of burning through the "critical dimension" of the grain is referred to.

Racer.—That part of a seacoast gun or mortar carriage which rests upon the traversing rollers. On gun carriages the chassis is bolted to the racer, and on mortar carriages the side frames are bolted to the racer.

Rammer.—A rod provided with a graduated brass ring; used for properly seating a projectile in the bore of seacoast cannon.

Ramp.—An inclined plane or foot path, serving as a means of travel from one level to another.

Rampart.—A broad embankment of earth around a place upon which a parapet is raised. A structure forming the substratum of every permanent fortification.

Range.—In a limited sense, the horizontal distance from the cannon to the target. In a general sense it is applied to horizontal distances between position finder and target, position finder and point of impact, cannon and point of impact, etc. The range of a shot is the horizontal distance from the cannon to the point of impact. The range appearing in the latest range tables and used in ballistics is the distance from the cannon to the point of fall measured along the surface of a sphere concentric with the earth and passing through the cannon. The range appearing in older range tables is the horizontal distance from the cannon to the point where the descending branch of the trajectory pierces the horizontal plane through the cannon.

Range-Azimuth Table.—A table of ranges and the corresponding azimuths from a gun to points in the center of the main ship channel or channels. It is kept at the gun and used for firing without the use of the range finding apparatus.

Range Board.—A device for obtaining the range corrections which must be made for wind, atmosphere, tide, and velocity.

Range Finder.—An instrument for determining the range to a target or object, from some fixed point.

Range Setter.—A specially qualified member of the gun section who lays the gun for range.

Range Table.—A compilation of data chiefly in tabular form intended to furnish the ballistic information necessary for directing the fire of a specified model of cannon with specified ammunition.

Rapid Fire Gun.—A single barrel breech-loading gun provided with breech mechanism, mounting, and facilities for loading, aiming, and firing with great rapidity. The breech mechanism is operated by a single motion of the handle or lever. The smaller calibers use fixed ammunition.

Rated Men.—Enlisted men who have passed examinations for the positions and who have been rated by the coast defense commander as gun commanders, gun pointers, observers, plotters, casemate electricians, chief planters, chief loaders, and coxswain.

Recoil.—The backward movement of the piece on firing. **Counter-recoil** is the forward movement of the piece in returning to battery.

Receiving Table.—The hoist table on which projectiles are placed preparatory to raising.

Recoil Cylinders.—Hydraulic cylinders for controlling the recoil.

Recoil and Counter-Recoil Buffers.—Devices on gun carriages for the purpose of reducing the shock due to abnormally excessive recoil or counter-recoil.

Reference Numbers.—The numbers used in the graduation of some of the scales of instruments employed in gunnery. The reason for their use is to avoid the liability to error that arises from the use of *right* and *left* in deflection corrections, and of *plus* or *minus* in range corrections.

Referring Point.—An auxiliary aiming point pertaining to only a portion of the pieces of a battery.

Registration Point.—A point on which fire is adjusted with a view to delivering more accurate fire on adjacent points.

Relocation of Target.—A process whereby the range and direction of a target from one point may be obtained without observation when the range and direction of the target is known from some other point.

Remaining Velocity.—The velocity of the projectile at any selected instant during its flight.

Rifle.—A cannon or gun with the interior surface of its bore grooved with spiral channels or cuts, thus giving the projectile a rotary motion. If the interior surface of the bore is not rifled, the cannon is known as **smooth bore.**

Ricochet.—A glancing rebound of a projectile after impact.

Rifling.—Helical grooves cut in the surface of the bore for the purpose of giving a rotary motion to the projectile. The rib of metal between two adjacent grooves is called a *land.*

Rimbases.—The masses of metal uniting the trunnions of a cannon with the trunnion band.

Rotating Band.—The copper band encircling projectiles near their base for the purpose of giving them angular rotation in passing through the rifling of the bore.

Round.—The firing of a single load from each gun of a battery not simultaneously.

Roving Light.—A searchlight intended to search the battle area within the field not covered by fixed lights.

Safety Lanyard.—A safety device attached to seacoast cannon consisting of a lanyard wound on a drum working against the action of a spring and attached to the gun. It is so arranged, by means of a rachet and pawl, that a pull on the firing lanyard cannot be transmitted to the primer until the gun is in battery.

Salvo.—The simultaneous or successive firing of a single shot from each piece of a pit, platoon, battery or other tactical group of armament.

Salvo Interval.—The time interval between successive shots of a salvo.

Salvo Point.—A point, the azimuth and range of which are known and conspicuously posted in the battery; at which a concentrated fire from one or more batteries may be directed. Certain points in narrow channels are usually selected as salvo points.

Salvo Table.—A table giving ranges and azimuths of salvo points.

Secondary Armament.—The armament of the coast artillery ser-

vice assigned to attack unarmored and lightly armored vessels. It consists of guns from 10 to 3 inches in caliber.

Seating Distance.—The distance from the face of the breech to the base of the projectile when the latter is in position for firing.

Securing Pin.—(Guns). Short, steel pins, usually four in number, placed radially near the muzzle to prevent the C hoops from moving forward over the tube and the tube from rotating due to the reaction of the rifling on the projectile.

Service Charge.—The maximum quantity of powder that is prescribed to be used in any seacoast cannon.

Serving Table.—A table for keeping a supply of projectiles convenient to the breech during firing.

Set Forward Point.—A point on the course of a target at which it is predicted that the target will arrive at the end of the predicting interval plus the time of flight for the range.

Shell.—A projectile with a large cavity for explosive.

Shell Filler.—An explosive used to make up the bursting charge in a projectile.

Shell Room or Shot Room.—A room for the storage of projectiles.

Shell Tracer.—A device attached to the base of a projectile which enables its flight to be followed. In the day time a smoke (which is visible) is emitted and at night a bright flame.

Shot.—A projectile with a small cavity for explosive; also the firing of a single load from a single gun or mortar.

Shot Hoist.—A device for raising projectiles from the hoist room to the loading or truck platform. Sometimes called **ammunition hoist.**

Shot Tongs.—A device used in lifting projectiles.

Sight.—A device by which the gun pointer gives the gun the proper direction for firing. Sights are of two classes, open and telescopic.

Sight Standard.—The upright of the carriage which supports the sight.

Site.—See angle of site.

Sleeve.—A tube into which a rod or another tube is inserted. If serving merely to strengthen the object which it encloses, it is a reinforce.

Slope of Fall.—The tangent of the angle of fall.

Smooth Bore Cannon.—See **Rifle.**

Star Gauge.—A device for measuring the diameter of the bore of cannon. It is used during the manufacture and when it is necessary to determine if any enlargement of the bore has taken place.

Striking Velocity.—The velocity of the projectile at the point of impact.

Subcaliber Tube.—A small gun which is fitted in the bore of a gun of larger caliber.

Superior Slope.—The top slope of a parapet or traverse.

Summit.—The point of maximum altitude on a trajectory.

Swell of the Muzzle.—The enlargement of the exterior of the cannon at the muzzle.

Targ.—The piece of metal (or other material) used to determine the intersection of the arms on the plotting board.

Tide Station.—A station at which periodical readings of height of tide are made, recorded and sent to the various stations.

Time of Flight.—The elapsed time from the instant the projectile leaves the bore to the instant that it reaches the point of impact. The values given in range tables are for the point of fall.

Time Interval Bell or T. I. Bell. A bell to indicate the observing interval. Bells ring simultaneously at the emplacements and the observing stations. They are operated by a clock or a motor.

Time Range Board.—A board to show range of target from battery at any instant. It is emplaced on the emplacement wall and is operated on data from the plotting room.

Throttling Bar.—A bar in the recoil cylinder to regulate the size of the orifice through which the liquid escapes from one side of the piston head to the other.

Throttling Pipe.—A pipe connecting the rear ends of two recoil cylinders. The throttling and the equalizing pipes are joined by a connecting

pipe through which liquid flows from one end of the cylinders to the other without passing through the piston heads. The amount of liquid which passes through the connecting pipes is controlled by the throttling valve. The recoil of the gun can be controlled to a certain extent by varying the setting of the throttling valve.

Trajectory.—The curve of double curvature described by the center of gravity of a projectile in flight.

Travel of Projectile.—The distance from the base of the projectile in its seat to the face of the muzzle of the cannon.

Traverse.—The structure protecting the armament and personnel from flank fire. Also a term used to indicate the horizontal travel of the piece on its carriage either to the right or left.

Traversing Rollers.—Rollers which rest upon the base ring and which enable the gun or mortar carriage to be given motion right or left.

Tripping.—The act of releasing the counterweights of a disappearing carriage, and thus causing the piece to go into its firing position.

Truck Platform.—If the ammunition trucks run on a different surface from that of the loading platform, this surface is called the *truck platform.*

Truck Recess.—The spaces built in the parapet wall for the storage of ammunition trucks.

Trunnions.—The cylinders supporting the cannon and about which it revolves in elevating and depressing.

Trunnion Band.—The hoop of which the trunnions of a cannon form a part.

Trunnion Sight Bracket.—A bracket attached to the trunnion of a cannon, which may be used for holding the telescopic sights.

Tube.—The inner cylinder of a cannon.

Twist of the Rifling.—The inclination of the grooves to the axis of the cannon at any point. When this inclination is constant, the twist is uniform; when it increases from the breech to a point near the muzzle, the twist is increasing. Twist is generally expressed in turns per caliber, e.g., one turn in fifty calibers, meaning that if the twist were uniform the projectile would make one complete rotation in passing over a distance equal to fifty calibers.

Vent.—A small channel leading from the exterior of the cannon to the powder chamber for the ignition of the powder charge. It is an **axial vent** when it is in line with the axis of the bore. It is a **radial vent** when it is at right angles to the axis of the bore.

Yaw.—The angle between the tangent to the trajectory and the longitudinal axis of the projectile.

Y-Azimuth.—A horizontal angle measured in a clockwise direction from the north point of the Y-Line through the observer.

Y-Line.—The origin line for the measurement of Y-azimuth. The north and south line of the Grid projection being used.

Zone.—In mortar firing, the area in which projectiles fall for a given charge of powder, when the elevation is varied between the minimum and maximum.

It is also used with reference to other divisions of the defensive area, as **outer defense zone, inner defense zone,** etc.

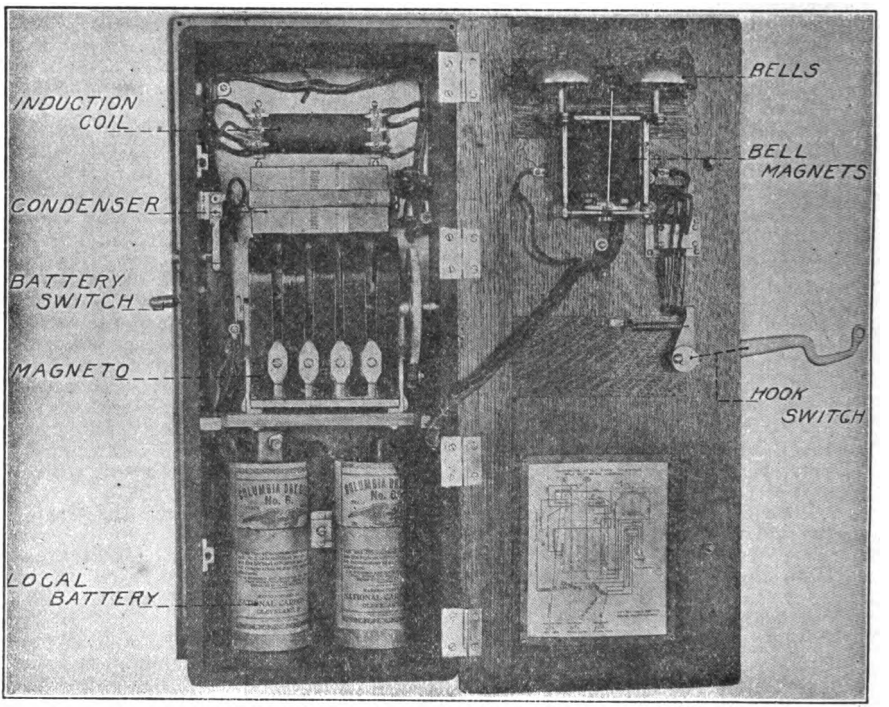
APPENDIX "C"

THE TELEPHONE*

THE INSTRUMENT

Q. What is the telephone?

A. A telephone is an instrument by means of which a sound produced at one end of a wire is reproduced at the other end.



COMPOSITE ARTILLERY TPPE TELEPHONE

Q. What two types of telephones are used in the Coast Artillery service?

A. The "composite artillery type" and the "common-battery artillery type."

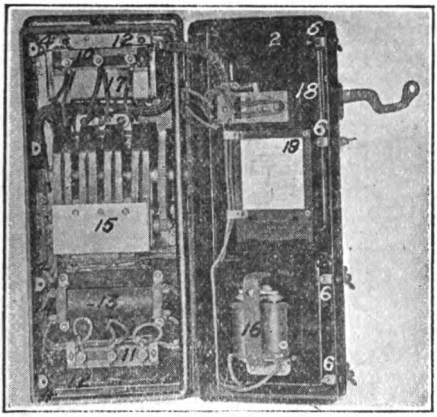
Q. What is the chief difference between the two types?

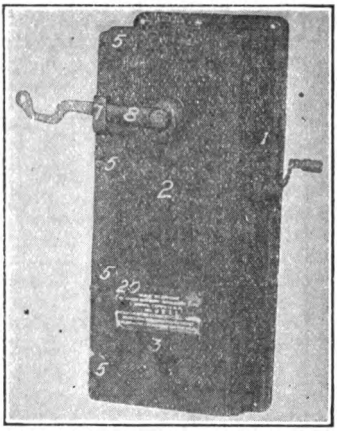
A. In the composite type use may be made of either a common or a local battery; while in the common-battery type only a common battery is used.

* This information about the telephone is not now required in the gunners' examination, but it is thought that it is sufficiently valuable to the enlisted man to warrant its insertion as an Appendix.

Q. What are the two classes of telephone "sets" in artillery work, and how are they used?

A. "Auxiliary sets" and "talking sets," so arranged that any of the talking sets can be used with any auxiliary set to make up a complete telephone. The auxiliary set contains all the local parts of the telephone proper, except the receiver and transmitter. The talking sets are the receiver and transmitter made up in different forms for different kinds of service.





COMMON BATTERY ARTILLERY TYPE TELEPHONE

1. METAL CASE, COMPLETE.
2. METAL CASE, DOOR FOR.
3. METAL CASE, METAL PLATE FOR PROTECTING GONGS OF RINGER, COMPLETE.
4. SCREW FASTENER, INTERNALLY THREADED.
5. WING BOLT FOR FASTENING DOOR.
6. ANGLE PIECE FOR SUPPORTING WING BOLT.
7. HOOK, STOP.
8. HOOK, COMPLETE.
9. HOOK RETAINER.
10. HARD-RUBBER STRIP WITH 3 WING-NUT BINDING POSTS, LINE.
11. HARD-RUBBER STRIP WITH 3 WING-NUT BINDING POSTS, TALKING SET.
12. WING-NUT BINDING POST, COMPLETE.
13. INDUCTION COIL.
14. INDUCTION COIL, TERMINALS FOR.
15. GENERATOR.
16. RINGER.
17. CONDENSER.
18. SWITCH, HOOK, COMPLETE.
19. PLATE, CIRCUITS.
20. NAME PLATE, DIRECTION.

Q. Name the different auxiliary sets.

A. Of the composite type: wall set; *plotter's set;* battery commander's set; portable set; and gun set.

Of the common-battery type: wall set; battery commander's set; portable set; and gun set.

Q. Name the different talking sets.

A. The head set, hand set, and desk set.

Q. What supplies the energy to operate the telephone?

A. Composite type: a central storage battery located in the switchboard room; or a local battery of two dry cells located inside the telephone.

Common-battery type: a central storage battery located in the switchboard room.

Q. What other telephones obtain current from the same central storage battery?

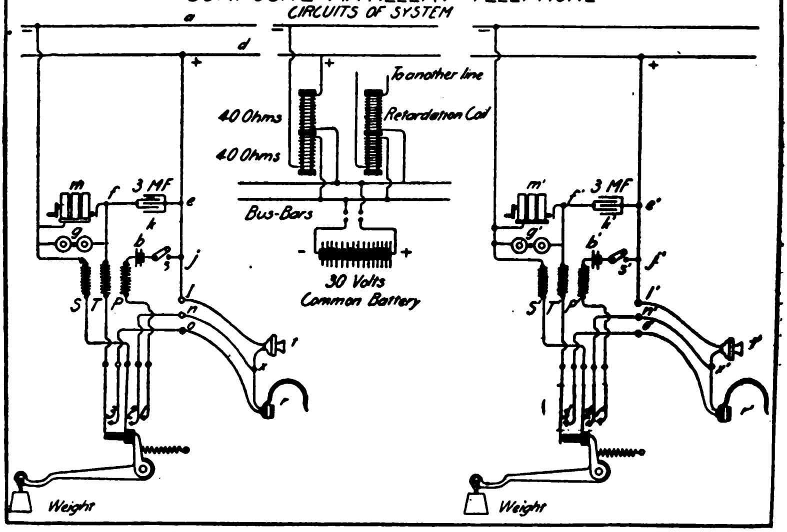
A. All the other telephones in the same fort command.

Q. What is the voltage across the terminals of the central storage battery?

A. 30 volts.

Q. Are these dry cells in the telephone now?

A. No; they are furnished only in time of war for use when the central storage battery fails.



COMPOSITE ARTILLERY TELEPHONE
CIRCUITS OF SYSTEM

Talking circuit: + bat., bus bar, retardation coil, + line, + binding post, e, j, l, t, x, n, contact 2, S, − line, retardation coil, bus bar, − bat.

Hearing circuit: T, f, k, e { j, l, t, - - - - - - - - - - / + line, e' {k', f', T', 3', o', r' / j', l', t' - - - - } - - - - - - - - - / x', n', 2', S', − line, S, 2, n, } x, r, o, 3, T.

Ringing circuit: m, f {g - - - - - - - - - - - - / k, e, + line, e', k', f', g', − line, m}

Q. Point out the battery switch (*of the composite type only*).

Q. What is its use?

A. It makes and breaks the local battery circuit.

Q. Upon which post should it be left?

A. Upon the post marked "Common Battery."

Q. How many circuits are there in this telephone?

A. Three: the primary, or talking circuit; the secondary, or hearing circuit; and the ringing circuit.

Q. Trace the primary circuit.

Q. What part does this circuit pass through?

A. The transmitter, the induction coil, the retardation coil and the hood switch.

Q. Point out the transmitter.

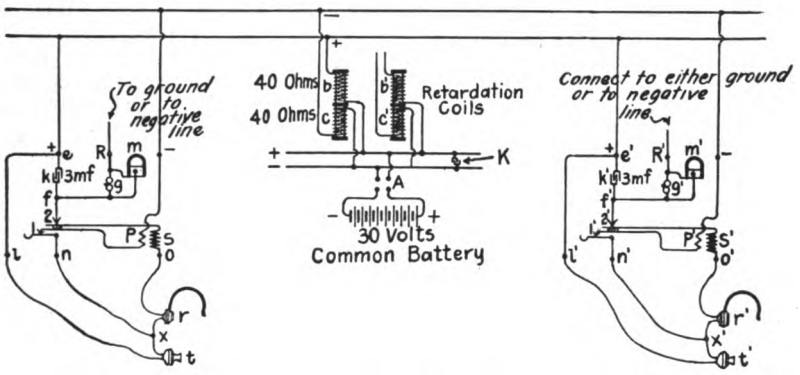
Q. What is its function?

A. The transmitter causes the strength of the current in the primary circuit to fluctuate whenever sound waves fall upon its diaphragm.

Q. Point out the Induction coil.

Q. What is its function?

A. The induction coil induces an alternating current in the hearing circuit in unison with the fluctuations in the talking circuit current.



COMMON BATTERY TELEPHONE CIRCUITS OF SYSTEM

Talking circuit:

+ bat., + bus bar, retardation coil b, + line, + binding post, e, l, t, x, n, hook switch contact 1, P, − binding post, − line, retardation coil c. − bus bar, − bat.

Hearing circuit:

Distant

S, hook switch contact 2, f, k, e, + line, e′, k′, f′, hook switch contact 2′, S′, o′, r′, x′, n′, hook switch contact 1′, P′, − binding post, − line, − binding post, P, hook switch contact 1, n, x, r, o.

Local

S, hook switch contact 2, f, k, e, l, t, x, r, o.

Ringing circuit:

Distant

Magneto m, R, through ground or negative line R′, g′, f′, k′, e′, + line, e, k, f, m.

Local

Magneto m, through g to magneto.

Q. Point out the retardation coil.

Q. What is its use?

A. It prevents the talking or ringing on one line from being heard on the other lines in the fire command.

Q. Point out the hook switch.

Q. What is its use?

A. It breaks the local circuit when the receiver is up, thus preventing the storage battery from running down. It also breaks the secondary circuit and allows the bells to be rung.

Q. Point out the line terminal posts.

Q. Trace the local branch of the hearing circuit.

Q. Trace the line branch of the hearing circuit.

Q. What parts are in the hearing circuit?

A. The receiver, the induction coil, the condenser, the transmitter and the hook-switch of both the local and distant phones.

Q. Point out the receiver.

Q. What is its use?

A. The object of the receiver is to reproduce sound waves when its coils are energized by the alternating current in the hearing circuit.

Q. Point out the condenser.

Q. What is its function?

A. It prevents the direct current from the storage battery from flowing through the bell and the generator. It also makes the talking more distinct.

Q. Trace the ringing circuit.

Q. What parts are in the ringing circuit?

A. The generator, the bell, and the condenser.

Q. Point out the generator.

Q. What is its function?

A. By turning the generator crank, the armature is revolved and an alternating current is generated which rings the bells.

Q. Point out the bell.

Q. What are its functions?

A. It rings to notify the operator that he is wanted.

Q. Point out the terminal posts for the head set.

Q. How can you tell which wire should be attached to each post?

A. The wires are of different colors and the terminal posts are labeled with the corresponding colors.

Q. What different kinds of composite artillery type telephones are there?

A. The wall telephone, the plotter's telephone, the gun telephone, the battery commander's telephone, the desk telephone, and the portable telephone.

Q. Tell how to open station.

A. (a) Take the head set or retaining spring off the hook and put on the head set.

(b) See that the connections are tight. These include the two connections to the line and three for the head set.

(c) Lower and raise the hook. A sharp click should be heard. A slight scratching in the transmitter should be heard in the receiver.

(d) Call the name of the distant station.

(e) To ring up the distant station, hold the hook down and turn the generator handle. Release the handle to converse. If any hooks on the line are up, none of the distant bells will ring.

Q. How is the station closed?

A. Call "close station" to distant station; hang receiver on hook or attach retaining spring; wipe off both receiver and transmitter.

Q. What care should be taken of the telephone?

A. Never leave the station with the hook up; keep the nuts on the terminal posts tight and the cords clear of tangles; polish up the outside nickel work once a week; keep the door shut; report trouble in the talking to the station chief.

APPENDIX "D"

List of Ordnance Pamphlets for Reference

(Where more than one number is given in one item, the numbers and subjects are in corresponding sequence.)

Nos.	Subjects.
1872	Ammunition, seacoast artillery.
1656 1657	Azimuth instruments, W. & S.: 1910; 1900, and 1900 MI
1665	Breech mechanism.
1666 1668	Board, deflection: gun, 1905; mortar.
1669 1672	Board, plotting: gun and mortar; 360°, mod. 1911, mortar
1663 1674	Board, range, gun: Pratt; 1909.
1676	Cannon and projectiles, table, U. S. Army.
1701	Carriage, 15-pdr., barb., 1903.
1683 1684	Carriages, 5-inch: balanced pillar, 1896; barb., 1903.
1686- 1688 1703 1704	Carriages, 6-inch: disap., L. F., 1898; disap., L. F., 1903; barb., 1901; disap., L. F., 1905; disap., L. F., 1905 MI.
1685 1689 1690	Carriages, 8-inch: barb., 1892; disap., L. F., 1894; disap., L. F., 1896.
1691- 1694 1700	Carriages, 10-inch: disap., L. F., 1894; disap., L. F., 1896; disap., A. R. F., 1896; disap., 1901; barb., 1893.
1695- 1697 1702	Carriages, 12-inch: disap., L. F., 1896; disap., L. F., 1897; disap., L. F., 1901; barb., 1892.
1712	Carriage, 14-inch, disap., L. F., 1907 and 1907 MI.
1698 1699 1705 1707 1709	Carriages, 12-inch mortar: 1891; 1896; 1896 MI; MII; 1908; 1896 MIII.
1706 1708 1710	Carriages, *Dummy:* 12-inch mortar, 1912; 15-pdr., 1912; 10-inch disap., L. F., 1912.
1727	Fuses.
1763	Gun, 6-pdr., and mount.

1768 Gun, 3-inch saluting and mount.
1756, 1766, 1772 Guns, 15-pdr.: 1898; 1902; 1903.
1749-1751 Guns, Armstrong, 4.72-inch: 40-cal.; 45-cal.; 50-cal.
1765 Guns, 5 and 6-inch.
1752 Gun, Armstrong, 6-inch.
1803 Hydraulic jacks.
1794 Indicator, wind component.
1795 Instruments for fire control system: care, preservation, etc.
1721 Loading projectiles with explosive D.
1869 Materials for cleaning, preservation, etc.
1820 Mortars, 12-inch.
1868 Paints for projectiles.
1873-1876 Position finders, depression: Lewis, 1898; Rafferty, B; Swasey; Lewis, 1907.
1946 Prediction scale, etc.
1738 Pressure gauge outfits.
1881 Primers.
1905 Range-finder, Barr and Stroud, 9-ft., horizontal, self-contained.
1952, 1955, 1956, 1958 Sights: for cannon; 3-inch telescopic; 2-inch tel., 1906; 2-inch 1906; 2-inch tel., 1909.
1888 Smokeless powder, etc., care of.
1986 Subcaliber guns.
1991 Targets.
2000 Telescope, observation, 1908.

APPENDIX "G"

COAST ARTILLERY
MEMORANDUM NO. 10.

WAR DEPARTMENT,
WASHINGTON, *November 25, 1910.*

The following abridged instructions for loading projectiles with Explosive D for use in instruction of gunners as contemplated in paragraphs 984 to 996, inclusive, Coast Artillery Drill Regulations, 1909, are published for the information and guidance of all concerned.

1. The service high explosive for bursting charges of projectiles for seacoast cannon is known as Explosive D. It is very insensitive to shock and, so far as known, can not be exploded by any means incident to handling or transportation. It has been adopted as a bursting charge in steel shell and shot of calibers from the 2.95-inch to 14-inch, inclusive. In projectiles smaller in caliber than 2.95-inch a different explosive is used as a bursting charge.

2. Explosive D is far more powerful and very much less sensitive than black powder. Its insensitiveness is illustrated by the fact that it is not exploded by impact of the projectile in which inserted against the hardest steel plate unless a detonating fuze is used in the shell.

3. Explosive D can be inserted in projectiles under pressure either by a hydraulic press or by hand with suitable ramming tools. The latter method having been found practicable, and not necessitating the installation of an expensive apparatus, has been adopted. The explosive used in projectiles under 2.95-inch caliber is compressed in the projectiles by means of a hydraulic press.

4. For convenience of reference projectiles are divided into three classes —minor, medium, and major caliber. Minor caliber projectiles comprise all projectiles from the 1-pounder to the 2.38-inch, inclusive; medium caliber projectiles comprise all from the 2.95-inch to the 7-inch, inclusive, and major caliber projectiles comprise all from the 8-inch to the 16-inch, inclusive.

5. To facilitate manufacture, all steel projectiles from the 5-inch to the 16-inch, inclusive, consist of two parts, the body of the projectile and the base plug, which is threaded to screw into a correspondingly threaded seat in the body. The base plug is provided with a fuze hole suitably tapped and counterbored for the fuze.

6. Projectiles under 5-inch in caliber, except a limited number of earlier manufacture, are not provided with base plugs, the fuze alone serving to close the cavity.

7. All steel projectiles using a bursting charge of high explosive are arranged to take a base detonating fuze with the exception of a limited number of 2.95-inch mountain gun and 3-inch field gun shell, which are arranged for a point detonating fuze. All projectiles below 4.7-inch caliber will be loaded and fuzed prior to issue.

8. Projectiles loaded with Explosive D require a detonating fuze to develop the force of explosion; the ordinary percussion fuze used to ignite black powder bursting charges has not sufficient power.

9. To eliminate the danger of premature bursts, due to the powder gases of the propelling charge passing the threads of the fuze and base plug and entering the cavity of the projectile, a copper base cover is crimped into an undercut groove in the base of the projectile after the detonating fuze has been inserted.

10. Explosive D is issued in barrels containing 125 pounds of explosive net. It should be stored in dry magazines or such other buildings as may be available for the purpose.

11. The room selected for loading projectiles with explosive D must be cleared of all other stores and thoroughly cleaned for the purpose (*especial care being taken to keep the explosive free from lime, dirt, or other foreign material*). Dust particles of the explosive must be cleared up at the end of each day's work, and the whole room must be carefully washed out after completing the filling of the projectiles on hand or when the use of the room is to be resumed for other purposes.

12. No metallic or other paints, except those especially provided by the Ordnance Department for the purpose, will be used in connection with the loading, especially for the interior of projectiles. Lead paints are particularly objectionable, as they are liable to act upon the explosive and form compounds very sensitive to shock.

13. No fire will be allowed in the room or in proximity thereto, and no matches will be allowed in the room. In other words, every precaution will be observed to guard against the possibility of accident.

14. Detonating fuzes will be handled carefully; dropping them on hard surfaces or marring or jamming them should be avoided.

15. Disassembling detonating fuzes at posts for any purpose whatever *is prohibited*. This prohibition is made especially to guard against the probability of accident on account of the sensitiveness of the fuzes.

16. As a rule, the fuze should be assembled in the projectile, and the base cover attached, on the day on which they are filled.

17. The projectiles prepared for service will be stored in a dry place, which must be fireproof and remote from danger of fire. The burning of a building in which these projectiles are stored would constitute a source of danger that must be avoided.

18. For unfuzed projectiles already issued to posts, the fuzes and base covers are held by the ordnance officers at the posts.

19. In loading projectiles with Explosive D their cavities are first carefully cleaned and then coated with ruberine or other authorized paint. When this has set the projectile is charged, the explosive being added in small quantities and rammed solid. The fuze seat is formed in the solid mass with suitable tools, after which the fuze is inserted and the base cover added and calked in place.

20. Projectiles charged with Explosive D, fuzed or unfuzed, have the whole surface in rear of the rotating band painted a deep yellow color.*

BY ORDER OF THE SECRETARY OF WAR:

LEONARD WOOD,
Major General, Chief of Staff.

OFFICIAL:
HENRY P. McCAIN,
Adjutant General.

* This has been modified in more recent orders.—Editor.

APPENDIX "F"

U. S. MAGAZINE RIFLE

DESCRIPTION OF THE OPERATION OF THE PRINCIPAL PARTS

Most of the operating parts may be included under the *bolt mechanism* and *magazine mechanism.*

The bolt moves backward and forward and rotates in the well of the receiver; it carries a cartridge, either from the magazine or one placed by hand in front of it, into the chamber and supports its head when fired.

The hook of the extractor engages in the groove of the cartridge case and retains the head of the latter in the countersink of the bolt until the case is ejected.

The safety lock when turned to the left, is inoperative; when turned to the right—*which can only be done when the piece is cocked*—the point of the spindle enters its notch in the bolt and locks the bolt; at the same time its cam forces the cocking piece slightly to the rear, out of contact with the sear, and locks the firing pin.

The bolt mechanism operates as follows: To open the bolt, raise the handle until it comes in contact with the left side of the receiver and pull directly to the rear until the top locking lug strikes the cut off.

To close the bolt, push the handle forward until the extracting cam on the bolt bears on the extracting cam on the receiver, thereby unlocking the sleeve from the bolt, and turn the handle down. As the handle is turned down, the cams of the locking lugs bear against the locking shoulders in the receiver, and the bolt is forced slightly forward into its closed position. The piece is then ready to fire.

To pull the trigger, the finger piece must be drawn to the rear until contact with the receiver is transferred from its bearing to the heel, which gives a creep to the trigger, and then until the sear nose is withdrawn from in front of the cocking piece.

Double loading from the magazine is prevented by the extractor engaging the cartridge case as soon as it rises from the magazine and holding its head against the face of the bolt until ejected.

The piece may be cocked either by raising the bolt handle until it strikes the left side of the receiver and then immediately turning it down, or by pulling the cocking piece directly to the rear.

The opening and closing of the bolt should each be done by one continuous motion.

To charge the magazine, see that the cut-off is turned up showing *on*, draw the bolt fully to the rear, insert the cartridges from a clip, or from the hand, and close the bolt. To charge the magazine from a clip, place either end of a loaded clip in its seat in the receiver and, with the thumb of the right hand, press the cartridges down into the magazine until the top cartridge is caught by the right edge of the receiver. The magazine can be filled, if partially filled, by inserting cartridges one by one.

Pushing the bolt forward, after charging the magazine, ejects the clip.

When the cut-off is turned down, the magazine is *off*. The bolt cannot be drawn fully back, and its front end projecting over the rear end of the upper cartridge holds it down in the magazine below the action of the bolt. The magazine mechanism then remains inoperative, and the arm can be used as a single-loader, the cartridges in the magazine being held in reserve. The arm can readily be used as a single-loader with the magazine empty.

When the cut-off is turned up, the magazine is *on*; the bolt can be drawn fully to the rear, permitting the top cartridge to rise high enough to be caught by the bolt in its forward movement. As the bolt is closed, this cartridge is pushed forward into the chamber, being held up during its passage by the pressure of those below. The last one in the magazine is held up by the follower, the rib on which directs it into the chamber.

In magazine fire, after the last cartridge has been fired and the bolt drawn fully to the rear, the follower rises and holds the bolt open to show that the magazine is empty.

Precautions

If it is desired to carry the piece cocked, with a cartridge in the chamber, the bolt mechanism should be secured by turning the safety lock to the right.

Under no circumstances should the firing pin be let down by hand on a cartridge in the chamber.

To obtain positive ejection, and to insure the bolt catching the top cartridge in magazine, when loading from the magazine, the bolt must be drawn fully to the rear in opening it.

When the bolt is closed, or slightly forward, the cut-off may be turned up or down, as desired. When the bolt is in its rearmost position, to pass from loading from the magazine to single loading, it is necessary to force the top cartridge or follower below the reach of the bolt, to push the bolt slightly forward and to turn the cut-off down, showing *off*.

In case of a misfire, it is unsafe to draw back the bolt immediately, as it may be a case of hang-fire. In such cases the piece should be cocked by drawing back the cocking piece.

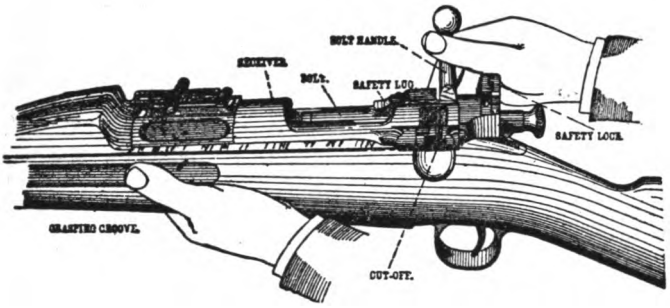
It is essential for the proper working and preservation of all cams that they be kept lubricated.

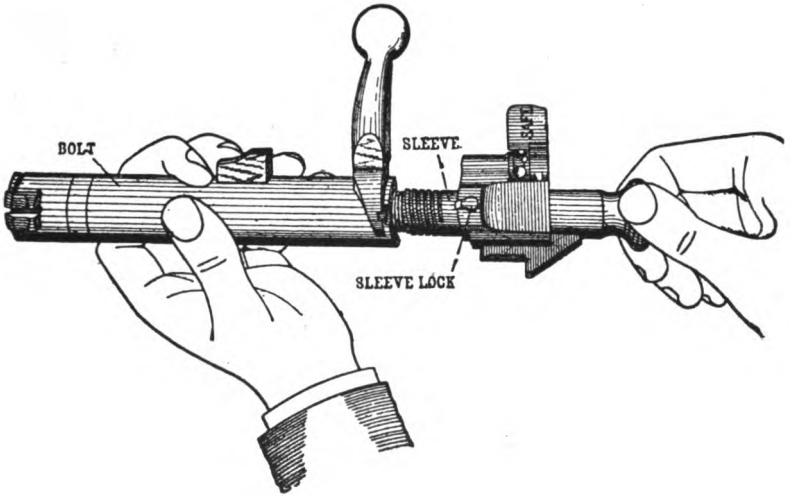
DISMOUNTING AND ASSEMBLING BY SOLDIER

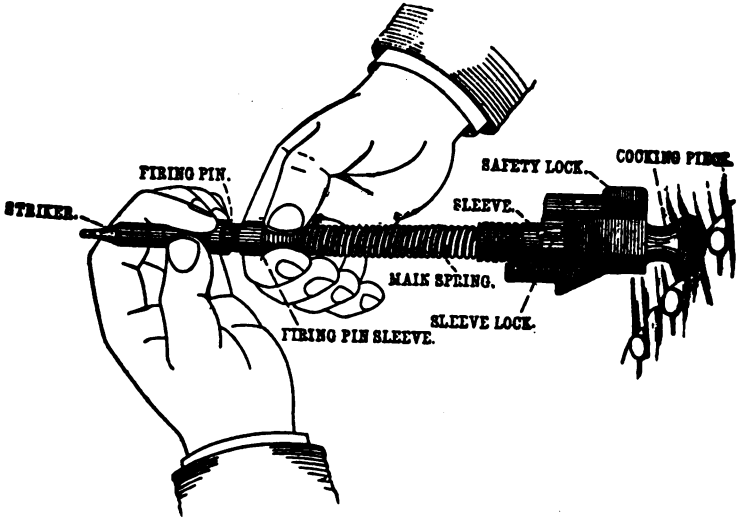
The bolt and magazine mechanism can be dismounted without removing the stock. The latter should never be done, except for making repairs, and then only by some selected and instructed man.

To Dismount Bolt Mechanism

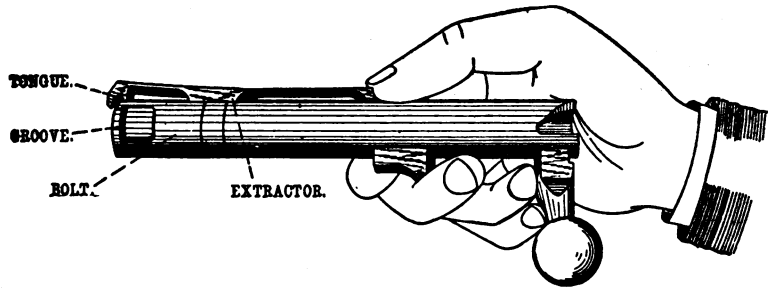
Place the cut-off at the center notch; cock the arm and turn the safety lock to a vertical position, raise the bolt handle and draw out the bolt. Hold bolt in left hand, press sleeve lock in with thumb of right hand to unlock sleeve from bolt, and unscrew sleeve by turning to the left. Hold sleeve between forefinger and thumb of the left hand, draw cocking piece back with middle finger and thumb of right hand, turn safety lock down to the left with forefinger of the right hand, in order to allow the cocking piece to move forward in sleeve, thus partially relieving the tension of mainspring; with the cocking piece against the breast, draw back the firing pin sleeve with





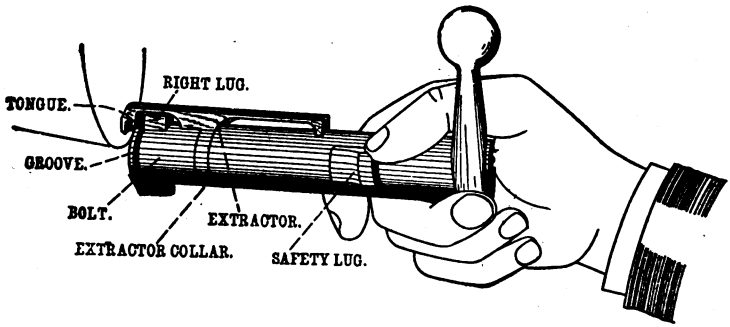


forefinger and thumb of right hand and hold it in this position while removing the striker with the left hand; remove firing pin sleeve and mainspring; pull firing pin out of sleeve; turn the extractor to the right, forcing its tongue out of its groove in the front of the bolt, and force the extractor forward and off the bolt.



To Assemble Bolt Mechanism

Grasp with the left hand the rear of the bolt, handle up, and turn the extractor collar with the thumb and forefinger of the right hand until its lug is on a line with the safety lug on the bolt; take the extractor in the right hand and insert the lug on the collar in the undercuts in the extractor by pushing the extractor to the rear until its tongue comes in contact with the rim on the face of the bolt (a slight pressure with the left thumb on the top of the rear part of the extractor assists in this operation); turn the extractor to the right until it is over the right lug; take the bolt in the right hand and



press the hook of the extractor against the butt plate, or some rigid object, until the tongue on the extractor enters its groove in the bolt. With the safety lock turned down to the left to permit the firing pin to enter the sleeve as far as possible, assemble the sleeve and firing pin; place the cocking piece against the breast and put on mainspring, firing pin sleeve, and striker. Hold the cocking piece between the thumb and forefinger of the left hand, and by pressing the striker point against some substance, not hard enough to injure it, force the cocking piece back until the safety lock can be turned to the vertical position with the right hand; insert the firing pin in the bolt and screw up the sleeve (by turning it to the right) until the sleeve lock enters its notch on the bolt. See that the cut-off is at the center notch; hold the piece

under floor plate in the fingers of the left hand, thumb extending over the left side of the receiver; take bolt in right hand with safety lock in a vertical position and safety lug up; press rear end of follower down with left thumb and push bolt into the receiver; lower bolt handle; turn safety lock and cut-off down to the left with right hand.

To Dismount Magazine Mechanism

With the bullet end of a cartridge press on the floor plate catch (through the hole in the floor plate), at the same time drawing the bullet to the rear; this releases the floor plate. Raise the rear end of the first limb of the magazine spring high enough to clear the lug on the floor plate and draw it out of its mortise; proceed in the same manner to remove the follower.

To assemble magazine spring and follower to floor plate, reverse operation of dismounting.

Insert the follower and magazine spring in the magazine, place the tenon on the front end of the floor plate in its recess in the magazine, then place the lug on the rear end of the floor plate in its slot in the guard, and press the rear end of the floor plate forward and inward at the same time, forcing the floor plate into its seat in the guard.

CLEANING AND CARE OF THE ARM

As the bore of the rifle is manufactured with great care in order that a high degree of accuracy may be obtained, it should be carefully cared for. The residuum from smokeless powder tends to corrode the bore and should therefore be removed as soon after firing as practicable. The following method has been practiced at the Springfield Armory for a number of years with good results: Using the cleaning rod and small patches of cloth (preferably canton flannel), clean the bore thoroughly with patches soaked in saturated solution of soda and water. Then thoroughly dry the bore and remove the soda solution by the use of dry patches, and finally oil the bore with patches soaked in cosmic oil. Twenty-four hours after this first cleaning, the bore should be again cleaned as described above, as it has been found that the powder gases are probably forced into the texture of the steel and will, if the second cleaning is not resorted to, cause rusting, no matter how thoroughly the bore may have been cleaned at first.

If, however, a cleaning rod is not at hand, the barrel should be cleaned as thoroughly as possible by means of the thong brush and rags, and oiled as above. To clean or oil the bore with rags, the thong brush is unscrewed, the rag placed in the rag slot of the thong tip and drawn from the muzzle toward the breech.

If gas escapes at the base of the cartridge, it will probably enter the well of the bolt through the striker hole. In this case the bolt mechanism must be dismounted and the parts and well of the bolt thoroughly cleaned.

Before assembling the bolt mechanism, the firing pin, the barrel of the sleeve, the body of the striker, the well bolt, and all cams should be lightly oiled.

Many of the parts can generally be cleaned with dry rags. All parts after cleaning should be wiped with an oil rag. The best method of applying oil is to rub with a piece of cotton cloth upon which a few drops of oil have been placed, thereby avoiding the use of an unnecessary amount of oil; this method will, even in the absence of the oiler, serve for the cams

and bearings, which should be kept continually oiled. Any part that may appear to move hard can generally be freed by the use of a little oil.

The stock and hand guard may be coated with raw linseed oil and polished by rubbing with the hand.

Sperm oil only should be used for lubricating metallic bearing and contact surfaces.

For the chamber and bore, only cosmoline or cosmic should be used. This should also be applied to all metallic surfaces, to prevent rusting when arms are stored or when not used for an appreciable length of time.

INSTRUCTIONS FOR CLEANING FROM "RIFLE MARKSMANSHIP"

52. *Use of the Cleaning Rod.*—Only the barrack cleaning rod should be used. The use of the thong and brush will be confined to occasions when the barrack cleaning rod is not available. There should always be two serviceable cleaning rods for each squad, and a plentiful supply of cut flannel cleaning patches, sperm oil, and cosmic. Post exchanges should keep a supply of sperm oil. Other more expensive and thin oils which flow off the metal and do not protect should be prohibited.

To use the cleaning rod for the cleaning and protection of the bore, remove the bolt and place the rifle in the cleaning rack. If a cleaning rack is not available, the muzzle of the rifle may be placed on a clean piece of paper placed on the floor. The cleaning rod is to be used only from the breech. Insert a cut flannel patch, slightly oiled, in the well of the receiver, and with the little finger center it and push it down over the rear of the chamber. Insert the tip of the cleaning rod from the rear of the receiver, center the patch with the tip, and push the patch into the bore and through the bore to the muzzle, then pull it back to the chamber, pushing and pulling it back and forth several times, and then finally push it out at the muzzle and discard it. Follow again with several perfectly dry, clean patches, and then with one saturated with heavy grease (cosmic). Note that such cleaning will not clean the bore after a cartridge has been fired. It simply cleans and protects the bore during ordinary garrison service when it is not being fired. The cleaning of the bore after firing is a chemical process which will be described below.

53. *Use of Patches.*—Never leave a patch in the bore or sticking in the muzzle. It will collect moisture and cause rust. The use of tompions (rags, sticks, or corks stuck in the muzzle) is prohibited. Men should be cautioned to use only good, new cut flannel patches for cleaning. If ordinary cloth, particularly old clothing, is used there is great danger that the cleaning rod will puncture the patch and stick in the bore, in which case the bore will probably be greatly injured in removing it. Men should not attempt to remove stuck patches, but should at once take such cases to the supply sergeant or mechanic. The flannel patch should be of the correct size so that it will slide through the bore with medium friction. A patch too thick or large is liable to stick, while one too small does not clean in the corners of the grooves.

54. *Cleaning the Bore after Firing.*—When the rifle has been fired the bore must be thoroughly cleaned not later than the evening of the day on which it was fired, and then must again be cleaned each day for three days thereafter. The barrack cleaning rod and cut flannel patches will be used as described in the preceding paragraph. First swab the bore thoroughly with two successive patches wet with the sal-soda swabbing solution. The

preparation of this solution is explained in paragraph 162, RIFLE MARKSMANSHIP.

The bore will then immediately be swabbed with a number of clean, dry patches until a patch run through the bore five or six times comes out fairly clean. The bore will then be examined by holding the breech up to the sky and looking through the bore from the muzzle. Examine the surface of the bore, particularly near the muzzle. If small flakes of bright metal are seen adhering to the surface of the bore, usually on the lands, this is metal fouling from the cupro-nickel jackets of the bullets, and the rifle should at once be taken to the supply sergeant or mechanic to have this removed with the standard metal fouling solution. If the bore appears spotlessly clean the soldier will then swab it thoroughly with a final patch saturated with heavy grease (cosmic), and will put it away in this condition until the next day, when it will be cleaned again in the same manner, first removing the grease with patches before applying the swabbing solution.

The combined residue of powder and primer is very acid. The sal-soda swabbing solution neutralizes the acidity of all the fouling that it can reach. Some of the fouling, however, is covered up by the slight metal plating that the barrel receives from the bullets, and this covered up fouling sweats out onto the surface of the bore for two or three days following the first cleaning. If it is not neutralized by again cleaning for three days after firing, it will attack the steel and cause rust. Rust always causes a permanent injury to the bore. Metal is always destroyed by the rust, and nothing can replace it. No matter how slight and superficial the rusting, the bore is always injured, becomes rough on the surface, picks up metal fouling readily, and gives an enlarged grouping of shots. No rust should ever be permitted to form.

55. *Other Powder Solvents.—Expedients.*—In lieu of the sal-soda swabbing solution issued by the Ordnance Department, riflemen may, if they so desire, use a swabbing solution composed of equal parts of amyl-acetate, acetone, sperm oil, and turpentine. This solution is particularly effective in the cleaning of .22 caliber rifles. There are several solutions of this nature on the market termed "powder solvents." All the effective ones smell strongly of "banana" oil.

In an emergency, when none of the recommended swabbing solutions can be obtained, the best substitute is water, preferably boiling water. Oil has very little effect on the residue of smokeless powder, and should never be used until the bore has been cleaned by the swabbing solution or the water and then thoroughly dried.

58. *When to Clean.*—Always clean at the end of the day's shooting. Never leave a rifle that has been fired overnight without cleaning.

Never shoot a rifle when it has any dust, dirt, mud, or snow in the bore. Wipe out the barrel with a clean rag before going to the firing point.

APPENDAGES AND ACCESSORIES

The oiler and thong case are carried in the butt of the stock. In one section is carried a small supply of sperm oil, and in the other the thong and brush used for cleaning the bore of the rifle.

The cap on the oil section is fitted with a wire, flattened at its point, which reaches to the bottom of the section and is used for applying oil, a drop or more at a time. *The oil is only for the lubrication of the working parts.* The cap is also provided with a leather washer to prevent leakage.

The cap on the thong section has a leather pad on its outer surface, which prevents the noise that would result from the oiler striking the butt plate cap. The oiler should always be inserted in the stock so that the leather-tipped cap will be next to the butt plate cap.

The cleaning rod is made of brass rod 0.25 inch in diameter, and of sufficient length to extend through the barrel.

The front sight cover is made of sheet steel and pressed into shape. It is then case-hardened, giving it sufficient spring to cause it to hug closely the barrel and front sight stud, thereby retaining its position on the barrel. It is used to protect the sight and should be kept in place at all times. During firing, it may be removed, if desired.

The screwdriver has a large blade, a small blade, a spur, a pin, and a rivet. The large blade should be used for the large butt plate screw, the butt plate spring screw, and the guard screws; the small blade for all other screws, except the cut-off screw, for which the spur should be used. The pin serves as a drift in removing the butt plate cap, ejector, floor plate catch, sear and trigger pins, and the lower band spring. No other screwdriver should be used in the repair of the rifle.

AMMUNITION FOR U. S. MAGAZINE RIFLE, MODEL OF 1903

Ball cartridge.—The caliber .30 ball cartridge consists of the case, primer, charge of smokeless powder, and bullet. The case is of cartridge brass. The head of the case is grooved to provide for extraction of cartridge from the chamber of the rifle. The initials of the place of manufacture, the number of the month, and the year of its fabrication are stamped on the head of case.

The primer consists of the cup, percussion composition, disk of shellacked paper, and anvil. The charge is of composition very similar to the powders used as propelling charges in field and seacoast guns. The normal charge weighs from 47 to 50 grains, varying with the lot of powder used. The bullet has a core of lead and tin composition inclosed in a jacket of cupronickel. It weighs 150 grains, and the point is much sharper and offers less resistance to the air than that of any previous model in the United States service. The standard muzzle velocity of this ammunition in the rifle is 2700 feet per second. The cartridge complete weighs about 395.5 grains, its weight varying slightly with variations in the weight of the powder charge. Five cartridges are packed in a clip. The clip body can be used a number of times, but the springs only once.

The gallery practice and dummy clip is provided with a strong bronze spring without tongues. Sixty ball cartridges in twelve clips are packed in a bandoleer. The bandoleer is made of olive drab cloth and contains six pockets, each holding two clips. The clips can be readily taken out by forcing back the fold of the pocket. The bandoleer is provided with a shoulder strap of olive drab webbing by which it is carried over the shoulder, and a safety pin is provided to afford an adjustment of its length to suit the convenience of the soldier. The bandoleer, with cartridges, weighs about 3.88 pounds.

Blank cartridge.—The *blank* cartridge, model of 1906, differs from the *ball* cartridge in the charge of powder and in the bullet, and in the fact that the case is tinned. The bullet is of paper, hollow, and contains a charge of smokeless powder, which insures the breaking up of the bullet on leaving the bore. A coating of paraffin on the outside of the bullet prevents the absorption of moisture by the paper. Model 1909 has no paper bullet.

Dummy cartridge.—The case of the dummy cartridge is tinned and provided with six longitudinal corrugations, also three circular holes in the corrugated portion. The tinning, corrugations, and holes afford unmistakable means for distinguishing the dummy from the ball cartridge, both by sight and touch. The bullet is the same as in the ball cartridge. The dummy primer has cup and anvil, but no percussion composition.

Guard cartridge.—This cartridge differs from the ball cartridge in the charge of powder and in the fact that second-class bullets having slight imperfections are used. Five grooves encircle the body of the case about the middle (old style), or six short straight grooves encircle it at the shoulder (new style), affording means for distinguishing it from the ball cartridge by either sight or touch. The charge gives a muzzle velocity of 1200 feet per second. This cartridge gives good results at 100 yards and has sufficient accuracy for use at 150 and 200 yards. The range of 100 yards requires a sight elevation of 450 yards, and ranges of 200 and 300 yards require elevations of 650 and 850 yards, respectively.

PARAGRAPH 292, ARMY REGULATIONS, 1913

"Enlisted men will not take their arms apart, except by permission of a commissioned officer under proper supervision, and only in the manner prescribed in the descriptive pamphlet of the arm issued by the Ordnance Department. The polishing of blued or browned parts of small arms, rebluing or rebrowning, putting any portion of an arm in a fire, or removing a receiver from a barrel, is prohibited. The mutilation of any part by filing or otherwise, and attempts to beautify or change the finish, are prohibited. Pieces will be unloaded before being taken to quarters or tents, and as soon as the men using them are relieved from duty, unless otherwise ordered. The use of tompions in small arms is forbidden. The prohibition in this paragraph of attempts to beautify or change the finish of arms in the hands of enlisted men is not construed as forbidding the application of raw linseed oil to the wood parts of the arms. This oil is considered necessary for the preservation of the wood, and it may be used for such polishing as can be given by rubbing in one or more coats when necessary. The use of raw linseed oil only will be allowed for re-dressing, and the application for such purpose of any kind of wax or varnish, including heelball, is strictly prohibited."

APPENDIX "H"

DEFLECTION RECORDER'S BOARD, RANGE BOARD, AND TIME-RANGE BOARD

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

DEFLECTION RECORDER'S BOARD

387. The deflection recorder's board consists of a plain blackboard about two feet square. It is placed on the wall of the emplacement where it can be seen by the gun pointer. The deflection recorder wears a telephone head set in parallel with that of the range recorder.

The deflection recorder records the last deflection received when it differs from the last one recorded, erasing the latter. The record is written in large heavy numbers about eight inches high.

RANGE BOARDS FOR GUNS OF MAJOR AND INTERMEDIATE ARMAMENT

(See First Class, (b) Duties in the Plotting Room, for illustration)

394. *Description.*—The range correction board is a mechanical computing device used in determining the corrected range to be transmitted to the gun emplacements. It consists of a *box*, a *chart frame*, a range-correction *chart*, a *marker system*, a correction *ruler*, *chains*, *sprockets*, and *counterweight*.

The *chart frame* is secured within and fills the interior of the box. The range correction *chart* is pasted on, with its range scale perpendicular to the bottom edge of the *chart frame*.

The range correction *chart* is provided with four sets of *correction curves* designated "atmosphere," "velocity," "tide," and "wind," a vertical range scale on each edge of the chart, horizontal range lines and data for accuracy tests. The *curves* are drawn to give the range correction for every 2 per cent variation in the density of the air, for every ten f.s. M.V., for every 5 feet of tide, and for every 10-mile range component of wind. The red line on the chart is a line of no correction and is called the *normal*. To avoid liability of error, *reference numbers* are used, instead of two sets of numbers with the plus and minus signs. The horizontal scale of the *chart* is 200 yards to the inch.

The *marker system* consists of a *bar* on which slide *markers* used to indicate the *correction curve* to be used in each set. The *bar* is attached to the box near its top.

The correction *ruler* consists of two *range scales*—one *fixed*, the other *movable*—both scales 400 yds. to the inch; two *bars*—one *fixed*, the other *movable*—; four movable *pointers* with *clamps*, one for each set of *correction curves*; a *gear system* for operating the movable parts; two *fixed indexes* and a *movable index* with *reading glass*.

The *clamp* for the *pointers* is so designed that each *pointer* is clamped independently of the others, either to the *movable bar*, to the *fixed bar*, or to both *bars* simultaneously. Any *pointer* clamped to both bars, locks the whole system and is called the *locking pointer*. To expedite operation,

outside *pointers* are alternated as the *locking pointer*. All other *pointers* are clamped to the *fixed bar*. The provision for locking to both bars serves two purposes: first, to provide against shifting the pointer when passing from one clamped position to the other; and second, to prevent the system from getting out of adjustment.

The *gear system* is designed to move by turning the *knob*, the pointers carried on the *movable bar* and the *movable range scale* simultaneously, the former moving twice the distance of the latter. The displacement of the latter records the aggregate motion of the *pointers*. The *knob* must never be turned, except when adjusting, while all four *pointers* are clamped to the fixed bar.

One end of each sprocket *chain* is attached to the *counterweight*. *Both chains* pass up through the middle of the top of the *box*, separate, and each passes over two *sprocket* wheels, thence down through the top of the box, and each is attached at its other end to an end of the *correction* ruler. The *ruler* can be moved up or down immediately in front of the correction *chart* and will remain at any position to which it is set.

Adjustments.—There are two adjustments for the range board.

First: Vertical adjustment. With the adjusting *screw* on one of the sprocket *chains*, set the two *fixed indexes* at the same range on the vertical scales on the correction chart.

Second: Horizontal adjustment. Clamp the *locking pointer* to the *movable bar*. Turn the knob of the *gear system* until the *pointer* is exactly opposite the *normal* of its set of correction *curves*. Clamp this *pointer* to the *fixed bar*. In like manner set each of the other *pointers* to the *normal* of its correction *curves* and clamp to the *fixed bar*. When all four *pointers* are at their *normals* and clamped to the *fixed bar*, turn the *knob* until the *movable index* indicates the same range on both *movable* and *fixed range scales*. Clamp one outside *pointer* only to both *movable* and *fixed bars*, locking the system.

Operation.—Set each *marker* at its proper correction *curve*. Set the *movable index* at the range to the set-forward point on the *fixed range scale*. Set the *fixed indexes* of the correction *ruler* at the range of the set-forward point on both *vertical range scales* of the correction *chart*. Clamp the *locking pointer* to the *movable bar*, and by means of the *knob*, set this *pointer* at the correction *curve* indicated by this *marker*. Then clamp to the *fixed bar*. Proceed in like manner with the other *pointers* in succession, locking the system with the last outside *pointer* used. The range on the *movable scale* at the *index* under the *reading glass* is the corrected range. The range board operator transmits this corrected range to the gun emplacements.

NOTE.—In operating the range correction board, it is not necessary to return any pointer to the normal of its set of correction curves. It is necessary only to set the ruler and index at the range for the set-forward point, and move each pointer directly to its proper correction curve. The correction curve is frequently imaginary, and lies between two of the plotted curves, in which case the p ointeris set on the imaginary curve, as indicated by the marker.

(*Inverse Problem*: *To find the velocity as a result of trial shots.*—Set th e ruler for range to the center of impact of the splashes. Set the movabl e index to the range to the center of impact of the splashes on the fixed range scale. Set the movable range scale to the range to the center of impact of

the splashes. Set the velocity pointer to the velocity assumed for trial shots and clamp it to the movable bar. Then shift the movable range-scale until it reads the range to the fixed point assumed as target for the trial shots. The velocity pointer will now indicate the velocity corresponding to the center of impact of the splashes.)

Tests of accuracy.—There are two tests for accuracy, viz:

For mechanical accuracy:

Use each set of *test points* marked on the correction *curves* and on the same range line and determine the corrected range. The true corrected range corresponding to each set is shown in brackets on the margin. Repeat several times for each set and record the difference of each determined range from the true range. The mean of these differences is the mechanical error. An officer should conduct this test, exercising the utmost care in operating the board.

For accuracy of the range board operator:

Direct method.—The range board operator uses the *test points* with the *index covered.*

Reverse method.—*After a series of corrected ranges have been determined* by the range board operator, the range officer will set each *pointer* at the *normal* of its set of correction *curves.*

The differences in ranges on the two scales under the index in excess of the mechanical error will be due to inaccurate work on the part of the range board operator.

Other methods of test may be devised if found desirable.

TIME-RANGE BOARD

Description

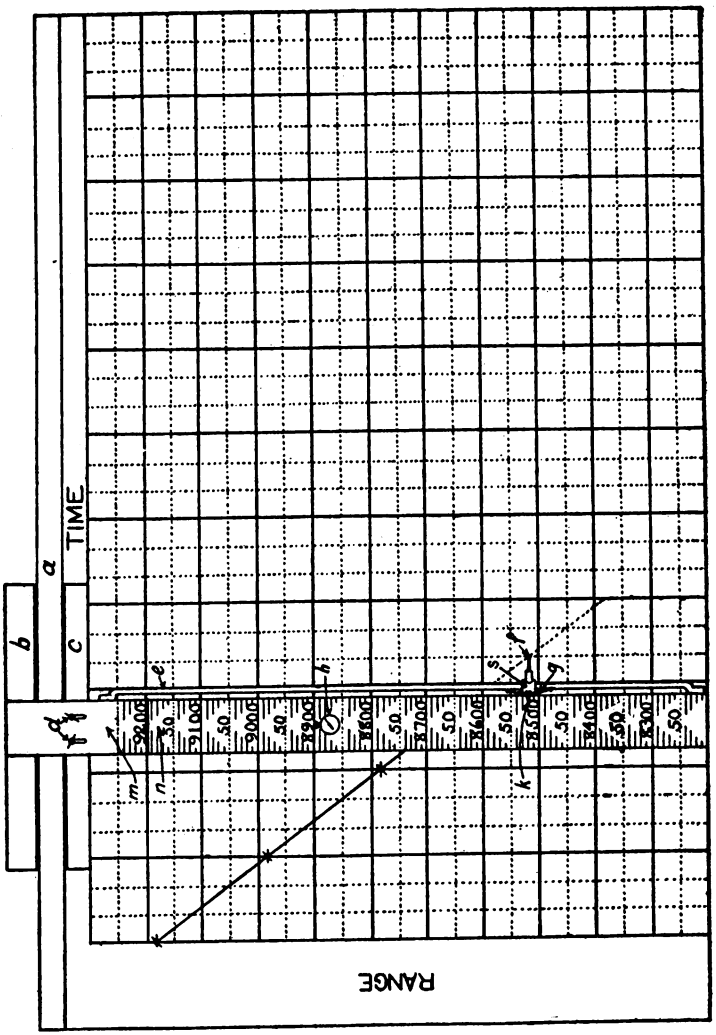
400. The time-range board consists of a blackboard approximately 9 feet by 6 feet in exterior dimensions, over which a T-square slides. It is ruled as shown in the accompanying diagram, the vertical lines representing time lines and the horizontal lines representing range lines. The distance between full range lines is 100 yards and the distance between full and broken range lines is 50 yards. The interval between full time lines is 30 seconds, and this interval is subdivided into 10-second intervals by dotted lines.

* * * * * * * * * *

A stop watch "h" (kept running with the time-interval bell) is hung at some convenient point on or near the T-square.

Operation

(a) Normal method with T-square.—When the first range is received by the range recorder (usually about 20 seconds after the instant of observation) he plots the range by a cross (X) in chalk on the first time line on the left of the board, opposite the proper point on the range scale. This marks the corrected range of the set-forward point for about ten seconds ahead. Similarly, the second range, when received, is plotted by a cross in chalk on the second time line. A full chalk line is drawn joining the two cross marks, and is prolonged by dots until the dotted line intersects the third time line. This plotting process continues as successive ranges are received by the range recorder until the last time line is reached, or until the plotted time-range line runs off the board, when the range is immediately transferred back to the first time line on the left and near the top or bottom of the board (making the necessary changes in thousandths and hundredth digits on the range scale), and the process is then continued as just described.



TIME: RANGE BOARD

The successive plotting of ranges should form a regular curve, the ordinates of which give the corrected ranges of set-forward points for any time of firing. The rate of increase or decrease in range is shown by the curve in such a manner as to be easily noted. Any range error made by the range section is revealed by a sharp break in the regular time-range curve. When such sharp break appears, the range recorder indicates the location of the point on the board by a small circle instead of a cross, but rejects it as a point of the time-range curve and continues the regular curve in a dotted line until it is ascertained precisely whether the break was due to an error or to a sudden change in the course of the target.

In the case of guns mounted on disappearing carriages, when the range recorder hears the command "Trip" he notes the time on the stop watch to the nearest five-second mark, and sets the T-square so that the right edge of the leg is adjusted to the time noted. He then moves the slide so that the end of the pointer touches the time-range curve. The subpointer now indicates the corrected range of the set-forward point for the instant of firing, and the range setter uses this range for setting the gun range-scale.

After the T-square and subpointer are set they are not moved until after the command "Ready" has been given.

No range is set on the gun-range scale until after the command "Trip." After the gun commander notes whether the gun goes fully into battery, he verifies the range setting. In case the range setting is wrong, he causes the range setter to correct it instantly and, if necessary, requires the range recorder to reset his T-square. After verifying the setting, the gun commander calls "Ready," and the gun pointer fires the gun, or, if friction primer has to be used, gives the command "Fire" as soon thereafter as the gun is pointed.

In case of guns mounted on barbette carriages, the operation is the same except that the T-square is set on a *selected starting time* instead of at the command "Trip," and the gun commander does not verify the range.

The range recorder stands in such position as will not interfere with the range setter's seeing the range indicated by the subpointer.....

(b) Alternative method without T-square.—The following method of using the time-range board without the T-square is authorized:

The time-range curve is plotted as described in (a). In this case, the ranges are placed on the time-range board, instead of on the T-square.

At a selected starting time (for example, the command *TRIP*) the range-setter (or some other member of the gun section to be designated by the battery commander), takes from the time-range curve, the corrected range of the set-forward point which will be the correct range setting if the gun is fired a certain definite number of seconds after the starting time (for example, 15 seconds). This range is set on the gun range scale.

The gun commander notes whether the gun goes fully into battery, verifies the range setting, and calls "*READY*" in time for the gun to be fired at the time corresponding to the range setting.

In case of a delay so that the gun cannot be fired at the correct time, a new range for a definite number of seconds ahead is taken from the time-range curve.

APPENDIX "I"

EXTRACTS FROM D. R. C. A., 1914

II. Organization

22. A gun company will be divided into sections as follows: one range section, and for each emplacement, one gun section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

23. A mortar company will be divided into sections as follows: One range section, and for each pit, one pit section. The sections will be subdivided into detachments and details for manning the matériel to which assigned.

25. The senior noncommissioned officer of each section, detachment, or detail is its chief. Each chief will command his subdivision and will be responsible for its drill, its efficiency, and the condition of the matériel to which it is assigned.

MARCHING MANEUVERS

The company is formed and marched off according to drill regulations. (Paragraphs 37 to 39).

To Post the Sections

40. The company commander marches his company to its battery or station, and as he approaches the battery or station commands *SECTIONS POSTS.* At the second command, each chief of section falls out of ranks, marches his section to a point near its emplacement or station, and commands *DETAILS POSTS.* At the second command all details fall out, procure equipments and implements, and take their posts.

Each chief of section determines whether all apparatus and material to be served by his section is in order, and reports to the officer directly over him, "Sir———in order" or reports defects he is unable to remedy without delay. As soon as the chiefs of section have reported, the officers report to the battery commander, who then reports to the fire commander "——— in order" (inserting name of battery), or reports defects he is unable to remedy without delay. (The reports from mine companies are made to the mine commander.)

If he so desires, a company commander may post the sections separately, at any point of the march, by commanding:———*SECTION, POST.* The section designated is posted as described above.

When a range section leaves the column, the range officer falls out and proceeds direct to his station.

Details for remote stations may be marched to their stations from the company parade by their respective chiefs.

To Dismiss the Sections

41. Battery commanders command *DISMISSED.* Range officers command *CLOSE STATION* (or *CLOSE STATIONS*). Emplacement officers command *REPLACE EQUIPMENTS.* Chiefs of sections command

FORM SECTION. The company is formed on the battery parade and is marched by the battery commander to the company parade and dismissed.

Subdivisions from remote stations are marched to the company parade and dismissed by their chiefs.

III. General Duties

OBSERVERS

61. Observers will be selected on account of their special aptitude. They will understand thoroughly the use of their instruments and will have a knowledge of the general characteristic features of warships. Each observer is responsible for the care and adjustment of his instrument and for the police of his station at all times, and will report to the range officer deficiencies, defects, or accidental damages as soon as they are known.

62. Ranges to moving targets as determined by depression position finders and coincidence range finders will be compared frequently (if practicable) with ranges as determined by a long horizontal base.

63. Observers will be tested frequently as to their proficiency in the practical use of the instruments to which assigned. The test will be conducted so as to determine the relative ability of various observers to read quickly and accurately ranges to fixed and moving objects.

THE GUN AND PIT COMMANDERS

69. Each emplacement of a gun battery is commanded by a gun commander and each pit of a mortar battery by a pit commander, who is responsible to the emplacement officer for the condition of the matériel and the efficiency of the personnel of his section. The gun (or pit) commander will supervise the gun cleaning and will require the mechanic to keep pieces and carriages in excellent condition. He will supervise the service of the piece.

70. The gun (or pit) commander will have charge of the entire emplacement under the emplacement officer, and during the absence of the emplacement officer, he will perform the duties prescribed for the emplacement officer. After the details have been posted as prescribed in Paragraph 40, he will command *EXAMINE GUN.* He will make a general inspection of the gun and carriage, paying especial attention to the recoil cylinders, the firing device, and the oiling of the various bearings. He will report to the emplacement officer, "Sir, No.——(or pit)—— in order," or will report defects he is unable to remedy without delay.

71. At the conclusion of the exercises for the day, he will command *FORM SECTION* after the emplacement officer has commanded *REPLACE EQUIPMENTS* (Par. 41). He will supervise the replacing of equipments and implements, will see that the piece is secured, and will then form his section on the battery parade.

THE GUN POINTER

72. A gun pointer is assigned to each gun in commission and is responsible for the condition and adjustment of the sight and sight standard. He will have a general knowledge of the characteristic features of warships. He will be tested frequently as prescribed in Par. 224.

THE MECHANIC

73. One mechanic, or acting mechanic, is assigned, under the gun commander, to each 8-inch (or greater caliber) gun emplacement, to each mortar emplacement, and to each battery of the intermediate or minor armament in

service. He is in immediate charge of all small stores and supplies at the emplacement or battery to which assigned.

GENERAL INSTRUCTION

203. The service of the piece will proceed with alertness and precision, and with as few orders as possible; aside from the necessary orders and instructions, no talking of any kind will be permitted. All movements of the cannoneers connected with the service of the piece will be made at a run.

206. At the command *TAKE COVER*, given at any time, all cannoneers not designated to remain at their posts will move at a run to some designated place under cover. As a rule this command will be given in mortar batteries only.

207. A drill primer or a fired service primer will be used at drill.

208. The primer will be inserted after the breechblock is locked. The cannoneer who inserts the primer will be instructed to exercise the greatest care in lowering the leaf of the firing device. Under no circumstances will he insert or remove the primer by means of the button or wire.

209. Service friction primers are adjusted in manufacture to require a pull of about 25 pounds to start the wire to the rear, and about 40 to 45 pounds to pull the teeth through the compressed friction pellet and explode it.

210. The lanyard will be pulled from a position as near the rear of the gun as possible. A strong, quick pull (not a jerk) with as short a lanyard as practicable, will be used.

211. Obturating primers are constructed so that when a primer is pulled and fails to fire, the primer wire is free to move forward without causing the composition to ignite. Extra precaution will be taken to prevent any attempt to use a primer that has failed.

212. Constant inspection of the safety pin on the firing leaf of the breech mechanisms in which combination primers are used will be made, since if the safety pin should be broken by harsh treatment and the pull upon the lanyard be upward by about 10° the primer probably would be ejected at the instant of firing and might injure the man firing the piece.

213. *Signals.*—The commands or signals, *ELEVATE*, *DEPRESS*, *RIGHT*, or *LEFT*, given in pointing, always refer to the direction of motion of the muzzle.

ELEVATE.—Raise either hand to the height of the head, fingers pointing upward.

DEPRESS.—Raise either hand to the height of the head, fingers pointing downward.

RIGHT or *LEFT.*—Motion with either hand, fingers pointing in the desired direction.

CLAMP.—Raise either hand with fist closed opposite neck, back of hand up, elbow bent and at height of shoulder.

HALT.—Raise and fully extend either arm vertically, hand and fingers open in prolongation of arm.

STAND FAST.—Raise and fully extend either arm horizontally straight to the front, hand and fingers open in prolongation of arm, back of hand up.

TAKE COVER.—Raise and extend fully both arms horizontally in prolongation of line of shoulders, hands open, fingers extended and joined, backs of hands up.

READY.—Raise either hand horizontally in front of forehead, fingers extended and joined, back of hand against forehead.

Care in Seating the Projectile at Gun Batteries of the Major Armament

215. The shot truck carrying the projectile will be brought up to the face of the breech and the projectile pushed carefully off the truck until the base of the projectile is just inside the powder chamber. The truck will then be withdrawn and run off to one side. The entire ramming detail will then man the rammer as near its outer end as possible. At the command *HOME RAM* by the chief of breech, the ramming detail will rush the projectile forward hard into its seat, increasing the speed of the rush so that the projectile will have its fastest movement when it comes up hard in its seat.

216. *Powder serving tray.*—For guns of the major and the intermediate armament, there will be made wooden serving trays, each having sufficient dimensions to carry all the sections of one powder charge. The tray will be so shaped that the forward end will cover the screw threads in the breech, and it will be provided with cross handles to facilitate handling. Powder sections will be arranged in the same order they will have in the powder chamber.

217. As soon as the rammer has been withdrawn after seating the projectile, the nose of the powder serving tray will be inserted in the breech by the powder servers, and the rammer detail, in one motion, will push carefully the entire powder charge off the serving tray to such a distance that the breech block will give the powder charge a final push into the chamber in closing. The tray will then be removed and the breech closed. At least two trays will be provided for each gun.

METHODS OF POINTING

223. Case I.—This method of pointing is used only with rapid-fire gun, where means for laying in elevation by quadrant have not been provided.

Direction and elevation are given by the sight.

The gun pointer adjusts the sight in its seat and sets the elevation and deflection scales for the indicated range and deflection, respectively.

Case II.—This is the normal method of pointing all guns. Direction is given by the sight, and elevation by an elevation or range scale attached to the carriage. For guns of the major armament the corrected range is taken from the time-range board. The gun pointer sets his sight to the deflection shown on the deflection recorder's board.

Case III.—This method of pointing is used exclusively for mortars. Its use for guns is auxiliary and is limited to batteries where the prevalence of fog or other local conditions render it necessary. Direction is given by the azimuth circle and elevation by the elevation scale or by quadrant.

In Case III, guns are fired on the bell. Corrected azimuths for the first or second bell after the data are received, are sent to the guns every thirty seconds. The gun pointer sets the azimuth for the bell on which it is desired to fire. The corrected range of the set-forward point for the same instant of firing is taken from the time-range board.

Pointing Tests

224. Pointing tests will be held frequently at gun batteries of the major armament in the following manner:

An assumed deflection for wind and drift is used during the test. This deflection is changed frequently during the drill so that gun pointers may not know the reading that should be obtained at the end of the time of flight. To accomplish this, the platen of the deflection board is set for the assumed

Deflection, and the setting is not changed as long as the same assumed deflection is used.

The gun pointer sets his sight at the deflection received from the plotting room, which is that obtained from the deflection board by combining the correction for angular travel during the time of flight with the assumed deflection for wind and drift. He gives the command *FIRE* as soon after the command *READY* as he is on the target; traversing is stopped and he then follows the target with the vertical wire. A noncommissioned officer equipped with a stop watch and a time of flight table starts the watch at the command *FIRE;* commands *HALT* and stops the watch at the expiration of the time of flight. The gun pointer stops following with the vertical wire at the command *HALT*, when the reading of the deflection scale should be the same as the assumed deflection for wind and drift. If not, the difference is the error in predicting and pointing.

Example.—Assumed deflection, 3.65; deflection sent to gun pointer, 3.20; reading of the deflection scale at end of time of flight, 3.60. 3.65−3.60 =0.05, the error.

For each trial, records will be kept of the range to the target and the deflection error; and the gun pointer will be informed concerning the amount of his error.

225. The excellence of a gun pointer's work is determined, first, by the accuracy of his pointing; second, by the promptness with which he is able to give the command *FIRE* after the piece is ready.

226. With disappearing guns it is important that the gun pointer be trained to get on the target in the time necessary to close the breech plus the tripping interval, so that in practice or action no time will be lost in pointing the gun after it is in battery.

Prediction Tests for Mortar Batteries

227. Prediction tests will be made frequently at mortar batteries in the following manner:

The battery commander is assisted by an officer, or noncommissioned officer, equipped with a stop watch and a time-of-flight table. The azimuth of a predicted point and the corresponding time of flight is sent to the battery commander, who sets his instrument to the azimuth of the predicted point, the vertical wire at normal. As the target passes the vertical wire of his instrument, he commands *FIRE*, and follows the target by turning the disc crank. The assistant starts the stop watch at the command *FIRE* and calls "halt" at the expiration of the time of flight. The battery commander ceases tracking and the assistant records the reading of the instrument.

The difference between this reading and the azimuth of the set-forward point as determined from the plotting board is the error in prediction.

Example.—Time of flight, 46⅝ seconds; azimuth of predicted point, 217.40°; azimuth of set-forward point, 214.49°; reading of the azimuth instrument, 214.59°; error in prediction, 0.10°.

Records of these tests will be kept and the results will be published to the battery command.

IV. Target Practice

PRECAUTIONS FOR SAFETY

233. Powder marked for one caliber or piece will not be used for any other caliber or piece of different chamber capacity.

238. When service ammunition is fired from guns (or mortars) above 4.7" in caliber, or when blank ammunition is fired from guns (or mortars) of any caliber, the powder chamber will be sponged and the mushroom head wiped off after each round and before loading for the next round, in order to insure the extinguishment of all sparks and the removal of smouldering fragments. The sponge and cloth used for this purpose will be dipped in liquid for sponging and the surplus liquid will be removed from them before they are used.

240. When firing, officers and men will be advised to place the authorized ear protectors, cotton, or small pieces of waste in their ears, but they will not be permitted to place the finger tips in their ears.

242. In case of a misfire in artillery practice the primer will not be removed and a new one inserted for at least ten minutes; during the interval, the piece will be laid on some portion of the field of fire where its discharge will not endanger shipping.

243. If firing by electricity, the circuit will be broken before the primer is removed. When using fixed ammunition and percussion primers, a second trial of the primer will be made if the firing device can be cocked by hand without opening the breech, but if this also fails, the breech will not be opened and a new cartridge substituted within ten minutes. If it is found necessary to open the breech when using obturating primers, the vent will be examined and cleared if necessary and the rear section of the powder charge will be pulled a little to the rear so that the mushroom head will push it to its place; the breech will be closed, and another primer will be tried.

244. At the command *CEASE FIRING*, lanyards will be detached. If using electric primers, the circuit will be broken. With rapid-fire guns using metallic cartridge cases, the breech will be opened. If firing is not to be resumed, fixed ammunition and separate powder charges will be withdrawn. Projectiles not loaded and fused will be driven back and withdrawn. Separate projectiles loaded and fused will be left in the gun until a favorable time to fire them; on no account will an attempt be made to drive them back.

SERVICE PRACTICE

235. Projectiles will be cleaned carefully before being inserted in the bore, lubricant will be removed, and the bourrelets will be freed of paint.

236. Immediately after a piece is fired, the breech will be opened and the primer will be removed.

237. Care will be taken to prevent injury to the gas-check seat and to keep it clean. If any residue from the priming charge drops from the obturator into the gas-check seat or the breech recess it will be wiped off.

239. Immediately after firing, the piece and accessories will be inspected by the battery commander and a report on their condition will be made by him (through the fire and fort commanders) to the coast defense commander. The bores of pieces will be washed clean with water, dried and oiled. The breechblocks will be dismantled, and all parts cleaned and oiled.

V. Care of Material

412. Coast defense structures, and the grounds surrounding them whose limits are prescribed by fort commanders, will be kept in proper police.

413. All open drains or gutters will be carefully swept at least once a week, and the sweepings so disposed of that they will not be carried back by wind and water.

414. Under no circumstances will drains, gutters, sumps, counter-weight wells, etc., be used as places of deposit for sweepings, waste, rags, and other rubbish. Drains and sumps will be inspected weekly, and will be kept in good order. Water fixtures will be inspected weekly, and leaky fixtures will be promptly repaired to avoid waste of water and possible damage.

421. The ammunition-service apparatus (trolleys, motors, and hoists) will be operated at least once each week, and the different working parts (pulleys, journals, etc.) will be kept clean and lubricated. Special care will be exercised in operating the motor starter and in preventing the jamming of any part of the hoists; also in the handling of projectiles at the receiving and delivery tables. The Hodges ammunition hoist is not designed and must not be used for lowering projectiles, either by motor or by hand power. The Taylor-Raymond ammunition hoist may be used with safety to lower projectiles by hand power, provided care be exercised and the hoist operated slowly; but the hoist must not be used to lower projectiles by motor power. Where emplacements are provided with cranes these will be used in preference to the Taylor-Raymond hoist for lowering projectiles.

For care of hoists, see Engineer Mimeographs, Nos. 46 and 137, and supplements.

423. *Oils* (see Ordnance Pamphlet No. 1869).—The important oils and lubricants supplied and uses therefor are shown in the following table:

Name	Use
Hydrolene	For filling recoil cylinders.
Kerosene	For cleaning purposes only, especially recoil cylinders.
Light slushing	For the bore, and for the bright parts of guns and carriages, when they are to remain unused for a considerable time.
Engine	For bright parts of guns and carriages when in daily use. For lubricating purposes where oil holes or plugs are provided.
No. 4½ Lubricant	For filling grease cups of heavy bearings.
Turpentine	For thinning paint.
Clock	For bearings of sights, position finders, etc.
Graphite	For use on heavy bearings in connection with 4½ lubricant, proportion 5% graphite to 95% lubricant *by volume*. Also for use on gas-check pads, proportion 50% graphite and 50% lubricant by *weight*.

Oils will be kept in closed receptacles, free from contamination, and will not be used a second time unless strained carefully. Discoloration does not in itself affect the serviceability of oils.

440. After firing, the powder residue will be removed by using the sponges well saturated with water. The sponges will be covered with sufficient burlap to make them a snug fit and insure reaching the bottoms of the rifling grooves. Flushing the bore with a hose immediately after firing facilitates cleaning.

441. The habitual position of guns on disappearing carriages will be "from battery." Guns on barbette carriages will be given an elevation of 5°.

442. All mortars (except model 1908) will be elevated habitually so that their axis will be parallel to the piston rod. The breech cover will be left off and the translating roller will be left in place. At forts where the sand blows into the breech mechanism and at all forts during the cold season where snow and ice may collect and form around the breech mechanism, the mortar will be kept elevated about 5° with the breech cover on. Model 1908 mortars will be kept elevated about 5° with the breech cover on.

443. *Care of carriages.*—When in use, all bearing parts will be cleaned and lubricated thoroughly. In all carriages, special attention will be given to the lubrication of gun trunnions, rollers, pintle surfaces, sliding surfaces, elevating, loading, and traversing mechanisms, including the teeth of all gears. On disappearing carriages, the following parts will be lubricated also: Gun-lever axle bearings, crosshead pins, tripping and retracting mechanisms, elevating rack and band trunnions, and crosshead guides.

Oil holes where provided will be cleaned out frequently to keep them free from sand and grit, and kept closed habitually by the screw plugs or covers provided, except during oiling.

Before oiling at any oil hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.

444. Compression grease cups will be filled with No. 4½ lubricant. The caps will then be screwed down on the cup until the spring rod projects about 0.25 inches above the top of the cap. This adjustment will be made from day to day, as required to maintain about this projection for the rod.

445. Care will be exercised that no water is allowed to enter the recoil cylinders when they are filled with oil or at any other time, for this will cause rusting of the interior of the cylinders, and in cold weather, it may freeze and burst the equalizing pipes or other parts of the recoil system.

448. All motors installed on gun carriages will be operated at least once each week if practicable for such length of time as will insure that they are in working order. When exposed to excessive moisture they will be operated for such further length of time as may be necessary to prevent accumulation of moisture in the motor cases.

450. On all seacoast gun carriages special care will be exercised to insure that bolts passing into hydraulic cylinders are tight at all times.

458. *Examination of the breech mechanism of mounted guns.*—The breech mechanism of mounted guns will be operated at least once each week, when practicable, and such parts of it as need cleaning will receive proper attention. If necessary, the tray will be removed in order to clean the worm, worm shaft, the spiral gear, and their recesses.

459. The mechanism will be oiled frequently, especially the filling-in disk, the worm shaft, ball bearings, and the hinge pin; engine oil is issued for this purpose. A mixture of 4½ lubricant and graphite is used on translating rollers. Special care will be taken to keep the primer seats clean and well oiled. Neglect of this permits rust, the removal of which enlarges the seat sufficiently to cause primers to stick.

460. *Firing mechanisms.*—Firing mechanisms will not be left on any gun or mortar out of service, but will be kept dismantled in the box provided for the purpose. All parts will be kept oiled and entirely free from dust.

461. *Piling projectiles.*—Projectiles when received at a fort will be unboxed and piled on suitable skidding with points to the wall, base out, so

that they may be inspected and fused easily. Care will be taken not to injure rotating bands. Should any rotating bands be found to be deformed, the raised portions will be filed down to the general exterior contour of the band. (See pars. 569 to 574, inc.)

465. *Dummy projectiles.*—Dummy projectiles, in order to work well, require that the bands be reasonably round and of sufficient diameter to make the projectile seat at about the position in the gun originally intended, and that the springs be of full strength. A little kerosene will be poured under the rotating band before each day's drill to cut any rust which may have formed and thus insure uniform conditions from day to day. The detailed methods of caring for these projectiles, outlined in Ordnance Pamphlet 1872, will be followed.

466. *Care of* * * * *primers.*— * * *

All obturating electric and friction primer cases will be cleaned immediately after firing and turned in to the coast defense ordnance officer for shipment to an arsenal.

VI. Storage and Care of Explosives

General instructions

479. All dirt, grit, and foreign material will be removed from cases before placing them in storage. In handling cases containing explosives, they will be raised, carried to the new position, and gently lowered. Rolling, sliding, or dropping cases must be avoided.

480. One of the most important requirements in the care of any explosive is absolute cleanliness in and about the place where the explosive is stored. By removing all foreign materials from a magazine, the chances of accidents are reduced. The ground around the storage place will be kept free from leaves, long grass, brush, débris, or anything which may increase the fire risks.

481. Officers charged with the receipt and storage of explosives will direct personally the work of handling the cases.

482. Cases will never be exposed to the direct rays of the sun longer than is absolutely necessary. They will be covered with a paulin or similar cover in such a way as to admit of the free circulation of air. The effect of the direct rays of the sun on a metallic case is to raise the temperature inside the case to a point considerably above that of the open air, and this temperature is maintained for a considerable time after the exposure.

483. In opening cases, implements which may produce sparks will not be used. Suitable implements are a wooden mallet, or a copper hammer with a wooden wedge or copper chisel. A hammer will be used only when necessary, and then as lightly as possible.

484. The keys of magazines and storage places will be kept in the hands of thoroughly reliable and responsible persons.

485. Whenever there is more than one kind of explosive in a storage place, but one kind will be placed in a pile, and the different kinds separated as much as possible.

486. The date of the receipt of any explosive at a fort will be marked on the outside of the container. Each separate package will be marked.

487. Only those explosives mentioned herein as being suitable for storage together will be placed in any single storage place.

488. Free circulation of dry air is most desirable in any place where explosives are stored. Cases will always be raised off the floor of the storage

place and placed on skids.

489. If a storage place is artificially heated, or from climatic conditions the temperature of the air is liable to rise above 85° F., a maximum thermometer will be suspended therein, the temperature will be watched carefully during the period of excessive heat, and the daily readings will be recorded on the proper Ordnance Department form. Should a temperature as high as 100° F. be maintained for any length of time, the place will be cooled or the explosive removed.

490. Black powder is now supplied to the service in relatively small quantities. It will never be stored with other explosives. It will be kept dry, and on account of the danger of explosion by ignition will be protected thoroughly from all fire risks.

491. Matches and unauthorized lights will not be permitted in any magazine.

492. No loose explosive will be permitted in any building, except such as is being used actually in preparing charges.

493. Empty ammunition cases will never be stored with filled cases.

494. A copy of these instructions will be hung in a convenient place in every magazine containing explosive, for the information and guidance of all concerned.

EXPLOSIVE D

Package

513. Explosive D is at present contained in double paper bags containing about 100 to 125 pounds of explosive. These bags are inclosed either in the standard cartridge storage cases or in strongly hooped wooden barrels painted inside with ruberine or other authorized paint. That manufactured in future will probably be packed in boxes as described for trotol.

Storage and Care

514. This explosive will be stored in a perfectly dry place, preferably in a magazine, as it has a slight tendency to absorb moisture. If it is impracticable to store in a magazine, the explosive may be stored in the dryest place available where it is protected thoroughly from all fire risks.

515. The barrels will be stored on end, marked end uppermost.

516. No cards or other material will be tacked on the barrel.

517. No nails will be driven in the barrel.

518. If from any cause the barrels of explosive are wet and there is a reasonable assurance that the interior has become wet, a barrel will be selected and opened. If the interior is wet, a full report of the circumstances will be made to the War Department. If the interior is dry, the barrel will be reheaded carefully and all barrels will be dried in the open air out of the direct rays of the sun.

519. Explosive D may be stored with wet gun cotton (15 per cent water based on dry weight of explosive), dynamite and trotol.

Inspection of Forts

520. No technical inspection of this explosive will be made at forts except by the Ordnance Department. Inspection at forts will ordinarily be limited to seeing that the rules for storage and care are strictly observed.

521. Barrels will not be opened for the purpose of inspecting the contents, except as indicated above.

522. If any barrel shows signs of drying out or opening at the staves or head, all barrels will be given a coat of ruberine or other authorized paint.

FUSES AND PRIMERS

Package

523. Fuses and primers are packed in hermetically sealed metallic boxes, inclosed in suitable wooden containers. These boxes will not be opened until the fuses and primers are required for use.

Storage and Care

524. Cases of fuses and primers may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to a temperature greater than 100° F.

525. All boxes containing fuses will be marked with metal labels, obtained from the Ordnance Department, clearly indicating the projectiles to which the fuses are assigned.

526. Under no circumstances will fuses and primers be stored with other explosives, except the commercial detonators used in submarine mines.

527. Fuses will not be disassembled for any purpose. Such action by inexperienced persons is liable to result in explosion.

Inspection

528. The inspection of this class of explosives will be limited to seeing that the requirements of storage and care are observed strictly.

SMOKELESS POWDER

Package

553. Powder charges are now supplied to forts in hermetically sealed cases and will be opened only in accordance with War Deparment instructions.

Storage and Care

554. Smokeless powder will be stored in the driest available magazines. So long as the container remains sealed, the only effect of water is to cause unusual deterioration of the case.

555. No magazine in which the temperature of the air rises above 95°F. will be used for the storage of smokeless powder.

556. Powder storage cases containing propelling charges will normally be piled on end with skids under the first tier and each succeeding tier. This arrangement may be departed from in case special facilities for piling the cases in some other manner are provided or in case the length of the storage case is so great relative to the diameter that there is danger of tiers falling down. If cases are piled on the side for any reason, particular care should be taken to separate them by skids rounded out to fit the contour of the case, as experience has shown that the piling of cases on their sides, either without skids or with ordinary skids, has a tendency to break the seals of the cases, causing them to leak.

557. Notwithstanding the great care taken in sealing storage cases it is almost impossible to prevent some slight escape of volatiles, therefore a slight odor of ether in a magazine does not indicate deterioration. However, if the ether odor is persistently strong, it indicates a leaky storage case, which will be found by a process of elimination.

558. Testing sets are issued to each coast defense command for use in testing containers intended to be kept sealed air tight. When a leaky case

is found or the seal of a storage case of powder discovered to have been accidently broken, the container will be securely resealed without delay, unless the container is badly damaged, the powder believed to have been wet, or there are other unusual circumstances, in which case report will be made to the armament officer.

Inspection by the Ordnance Department

559. Samples of each lot of smokeless powder issued to the service are preserved in the laboratory of the Ordnance Department for chemical test. These retained samples are subjected regularly to technical inspection and test by that department to determine their condition as to stability. Should any lot show deterioration, the change is discovered by such inspection and the entire lot recalled from forts where it is stored.

Inspection of Forts

560. With each lot of powder supplied to a fort there is furnished a ground-glass-stoppered bottle containing a sample of the particular lot of powder. This bottle will be stored in the magazine with the corresponding lot of powder. The object of preserving this sample bottle in the magazine is to enable the responsible officer to keep his powder under regular observation.

561. A strip of dry tenth-normal methyl violet paper will be kept in each sample bottle at all times. The paper gradually loses its color in the presence of oxides of nitrogen as given off by decomposing smokeless powder. The time of test is the number of days required for the paper to lose all color and become entirely white.

562. A fresh strip of test paper will be inserted in the bottle every 30 days and will have entered on it in pencil the date when inserted. If desired, old strips may be left in the bottle for 30 extra days. All strips will be examined from time to time to detect change of color. The examination will be made without removing the stopper, except when the test paper is to be inserted or removed. The bottle will never be left open longer than is absolutely necessary, since the absorption of moisture and loss of volatiles due to exposure to the atmosphere affect the powder, while the escape of nitrous fumes that may have formed in the bottle delays the completion of the test. A perfectly stable powder will give a test of 60 days or more, but a test of 30 days indicates that the stability is reasonably satisfactory. If any sample causes the paper to turn completely white in 30 days or less, a report will be submitted by the coast defense commander, giving the data indicated on the blank form provided for that purpose.

563. Methyl violet paper is not affected by diffused light or ordinary handling, but will not be exposed to direct sunlight nor soiled by careless handling. Care will be taken not to handle the sample powder grains with moist fingers or to otherwise contaminate them.

* * * * * * * * *

PROJECTILES, FILLED AND FUSED

Storage and Care

569. These projectiles will be stored in the magazines provided for them, piled, and painted as required by existing orders.

570. They will be kept dry as possible and free from rust.

571. While premature explosions are not expected, projectiles filled and fused will be handled with great care.

Inspection

572. On account of the nature of the envelope, no inspection of the explosive is possible. The inspection of the projectiles will be limited to seeing that the requirements of "Storage and Care" are observed strictly.

PROJECTILES, FILLED BUT NOT FUSED

573. The fuse hole plugs should be set up fairly tight to exclude moisture. Fuse seats should not be formed unless it is actually intended to insert fuses. No danger from handling is to be expected, but care will be taken. The necessary fuses, base covers, etc., required to complete their preparation for service should be on hand at all times in boxes properly marked for identification.

Inspection

574. As prescribed for projectiles, filled and fused.

FIXED AMMUNITION

Storage and Care

575. Fixed ammunition for small arms or for cannon will preferably not be stored in the same magazine with other explosives. If the magazine is damp, the boxes will be piled on skids with strips between tiers and a space between boxes in a tier to permit the free circulation of air around the boxes.

Inspection

576. The inspection at forts will be limited to seeing that the requirements for its storage and care are observed strictly.

APPENDIX "J"

U. S. AUTOMATIC PISTOL, CALIBER .45

MODEL OF 1911

Q. Point out the following parts:

Receiver	Plug
Barrel	Extractor
Slide	Ejector
Slide stop	Firing pin
Rear sight	Hammer
Front sight	Disconnector
Link	Trigger
Link pin	Grip safety
Barrel bushing	Safety lock
Recoil spring	Magazine
Recoil spring guide	Magazine spring
	Magazine catch

Q. What is the kind and weight of the charge of powder for the pistol cartridge?

A. Smokeless powder. The weight varies slightly, but is about 5 grains.

Q. Describe the bullet for the pistol cartridge.

A. The body of the bullet is a cylinder. It has a core of lead and tin composition inclosed in a jacket of cupro-nickel. It weighs about 230 grains.

Q. What is the muzzle velocity of the pistol cartridge?

A. 802 feet per second.

Q. Why is this pistol called the automatic pistol?

A. Because, on being fired, the work of opening the breech, cocking the hammer, extracting and ejecting the empty shell, and forcing a new cartridge into the chamber, is done automatically by the force of recoil.

Q. How is this done?

A. The recoil forces the slide back; as it moves to the rear it compresses the recoil spring, opens the breech, extracts and ejects the empty shell, and cocks the hammer; the recoil spring then sends the slide forward, and in the forward movement it forces the new cartridge, which is pushed up from the magazine by the magazine spring, into the chamber ready for firing.

Q. How rapidly may the pistol be fired?

A. It has been fired twenty-one times in twelve seconds. Under ordinary conditions it may be fired as rapidly as the soldier is able to aim and pull the trigger.

Q. How is the pistol rifled?

A. It has six grooves, 0.1522 inches wide and 0.003 inches deep, and six lands 0.072 inches wide. The twist is to the left, one turn in 16 inches

Q. What effect has this left-handed twist on the trajectory?

A. It causes the bullet to drift to the left.

Q. How is drift overcome?

A. It is more than overcome by the pull on the trigger when the pistol is fired from the right hand.

Q. For what use is the pistol intended?

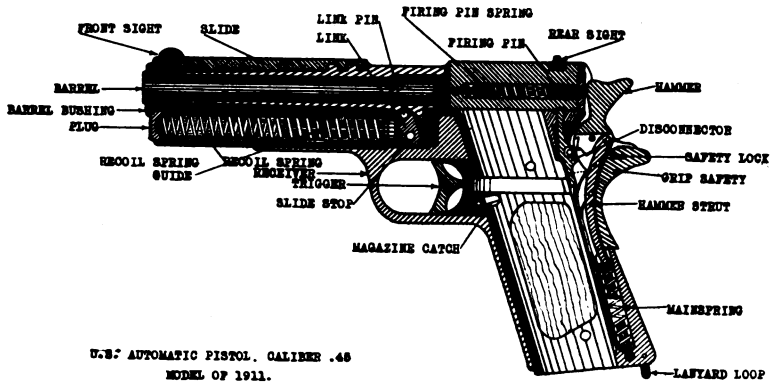
A. It is an emergency weapon for use at short ranges.

Q. For what ranges is the pistol accurate?

A. For ranges up to 75 yards.

Q. With what safety devices is the pistol provided?

A. It is impossible for the firing pin to touch the primer except on receiving the full blow of the hammer. The automatic disconnector prevents the release of the hammer unless the slide and barrel are in the firing position, and also prevents more than one shot from following each pull of the trigger. The automatic grip safety at all times locks the trigger unless the handle is firmly grasped as in firing, which pushes the grip safety in and releases the trigger.



U.S. AUTOMATIC PISTOL, CALIBER .45
MODEL OF 1911.

Q. What oil may be used on pistols?

A. For metallic surfaces, sperm oil, cosmic, or other oil furnished by the Ordnance Department. When pistols are stored, cosmic is used. Raw linseed oil may be used on the wooden portions of the stock.

APPENDIX "K"

THE BATTERY COMMANDER'S TELESCOPE MODEL 1915

(Scissors Telescope)

Q. What is the B. C. Telescope, Model of 1915?

A. It is a land observation instrument of the binocular type. It may be used with the telescope tubes in the erect position for periscopic vision or in the horizontal position for stereoscopic vision.

Q. What is meant by periscopic vision?

A. When the telescope tubes are erect the instrument may be used to look over an obstruction while the observer remains concealed or protected.

Q. What is meant by stereoscopic vision?

A. When the tubes are in the horizontal position, the distance between the objective prisms is about 10 times as great as that between the eye pieces. This causes the objects viewed to be brought strongly into relief.

Q. How is the instrument graduated to read horizontal angles?

A. In mils, in a clock-wise direction.

Q. Where are these angles read?

A. The hundreds of mils are read on the azimuth scale which is graduated into 64 equal divisions, each representing 100 mils, and mils are read on the azimuth micrometer which is graduated into 100 equal divisions each representing one mil.

Q. Where are the angles of sight read?

A. On the angle of site scale which has graduations reading from 0 to 6, each division representing 100 mils and on the angle of site micrometer which is graduated into 100 equal divisions each representing one mil.

Q. How large an angle of site may be read?

A. The instrument has a movement of 300 mils in elevation and 300 mils in depression.

Q. What is the method of measuring angles of site?

A. The telescopes are focussed on the point in question and the horizontal line of the reticule brought on the point by means of the elevation knob. The angle of site level bubble is then brought to the center of the tube by turning the angle of site micrometer knob. The angle of site is then read from the scale and micrometer. Since 300 mils is the reading for zero angle of site, angles less than 300 mils will be angles of depression and angles greater than 300 mils will be angles of elevation.

Q. Explain how this instrument is set up?

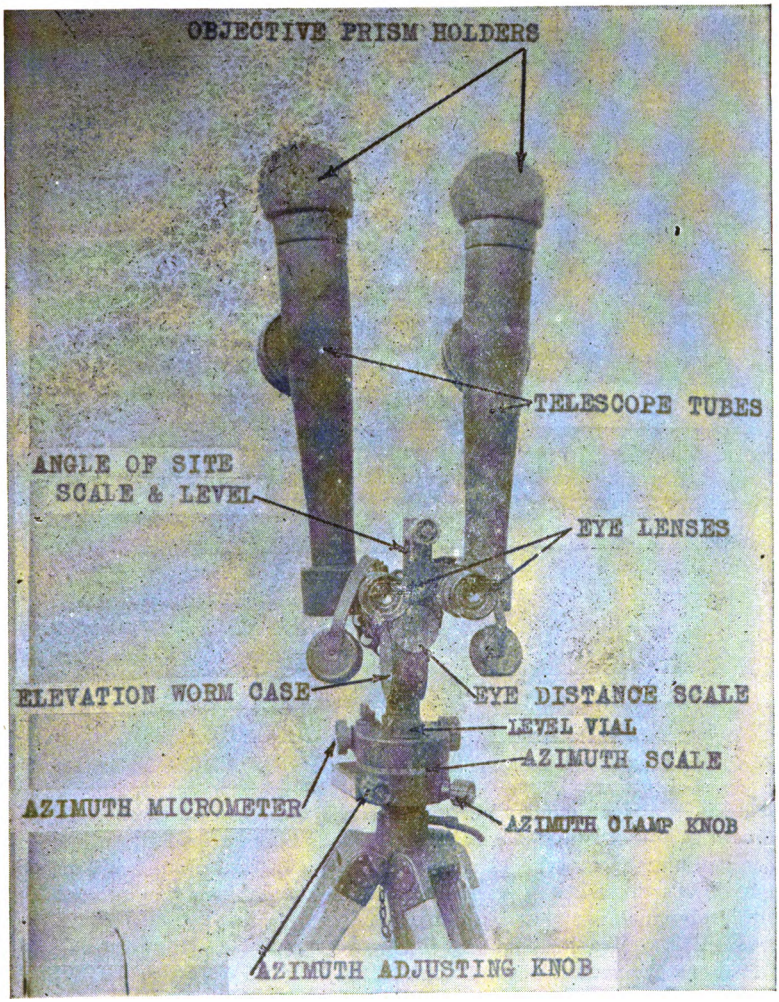
A. 1. Set up the tripod—see that the legs are evenly spaced, securely fixed in the ground and clamped.

2. Level the head by means of the vertical spindle ball and socket joint and the level bubble. Tighten the vertical spindle clamp.

3. Holding the locking plunger in the release position (pushed in) set

the telescope down upon the vertical spindle. When all the way down it will lock in position.

4. Focus the telescope. Each eye piece should be focussed separately on a far distant object until it appears as distinct as possible. The numbers



opposite the index on the diopter scales on each eye piece should then be memorized for future use.

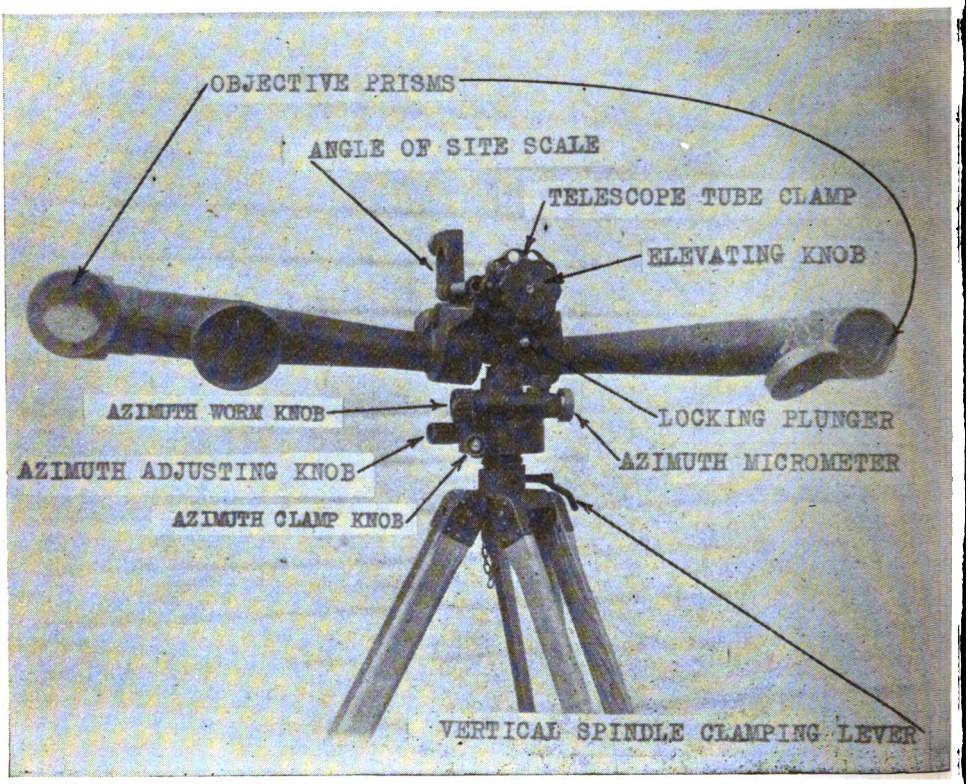
5. Move the telescope tubes (in either vertical or horizontal position) until both fields of view appear as one. The eye pieces are now the proper distance apart, and the resulting number opposite the index on the eye-distance scale should be memorized for future use.

Q. Explain how to orient the instrument.

A. 1. Having set up the instrument, set the azimuth scale and micrometer to the azimuth of the known datum point.

2. Loosen the azimuth clamp knob and turn the instrument so that it is approximately on the point. Tighten the azimuth clamp knob.

3. By turning the azimuth adjusting knob bring the vertical line of the



reticule in the right hand telescope exactly on the datum point. The instrument is now oriented and azimuths in mils may be read by turning the upper motion. It may be turned freely by using the azimuth worm lever which throws the azimuth worm out of mesh, or by means of the azimuth worm knob which is a slow motion screw.

CAUTION: When the instrument has been oriented, care must be taken not to touch the azimuth clamp knob or the azimuth adjusting screw knob.

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